MAY 1964 35 CENTS ICD

SCIENCE DIGEST

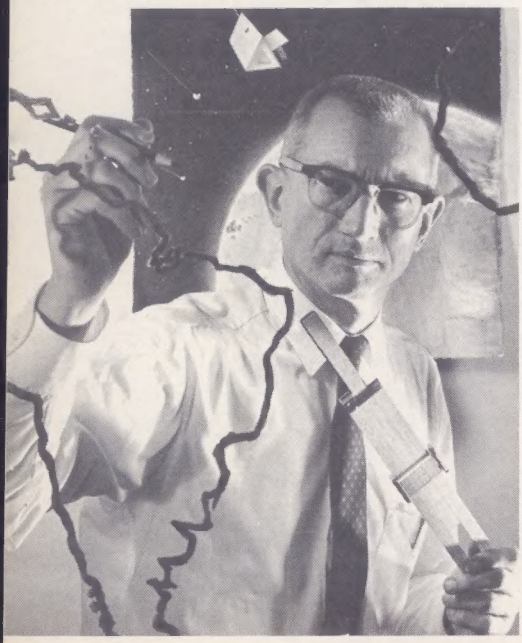
THE 'SAFE' CIGARETTE

WHO REALLY WINS THE INDIANAPOLIS

SCIENCE LOOKS AT BEATLEMANIA

WHAT HAPPENS WHEN YOU DIE

Pairs of satellites will be used to reflect navigational signals back to earth.



The navigation system was conceived by E. Roy Anderson of G.E.'s Schenectady labs.

Instant navigation

TWELVE pairs of satellites and six ground stations are all that would be needed for a navigation system that could instantly locate ships and aircraft, within one nautical mile, anywhere on earth.

The system, proposed by General Electric, would work like this:

Upon leaving its base, a ship or aircraft notifies the nearest of the six ground stations. The station has a special code for each ship or aircraft using the system.

At set intervals, the codes are transmitted to the craft by way of the satellites within the ground station's range. The satellites serve as reference points.

The ship or aircraft recognizes its own code and sends a return message the same instant.

By measuring the time delay between transmissions, and by prior knowledge of the satellites' positions, computers can pinpoint the location of the craft.

G.E. scientists feel such a system would be particularly useful for the new supersonic aircraft. A craft's position could be defined so quickly that the system could fix the location of a supersonic plane in "real time" (while its actually there).

Ground stations could also be used to monitor meteorological data from isolated parts of the world. Another possible use: Signaling devices could be placed on icebergs to provide information on their location.

SCIENCE DIGEST

Twenty-eighth year of publication

photo C. N. Barnard

To the average "Indy" fan it's the driver who wins the race. But experts know the designer is the one who really captures top honors. Meet two of this year's best designers in the story that starts on page 8.

MAY • 1964 VOL 55, NO. 5

ARTICLES

FEATURES

★ ★ ★

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TO LETTERS SCIENCE DIGEST

Cuber si

Hurrah! for Dr. [John F.] Cuber. Is it possible for you to send me five copies of the article on his studies, "Marriage As It Really Is" (Feb. '64)?

ALYCE MACRONALD
Rye, N.Y.

Would it be possible for me to obtain a reprint of the article? . . . I am a student of sociology and found this article most interesting.

RONALD D. AMON
Richmond, Va.

Regarding Dr. Cuber's search for romantic love. Each individual human being has his or her own personal power mechanism. All emotion is simply an irresistible involuntary expression of the power of human magnetism which governs natural human attractions and revulsions. When individual power lines of equal force and equal velocity cross each other, the result is the natural phenomenon known as romantic love. The impact

is so positive and the energy released is so explosive that the action not only is felt by the two human beings directly concerned, but is also obvious, fascinating and energizing even to casual observers.

MEG RICHARDSON
Toronto, Canada

Cuber no

I look forward each month to reading *Science Digest*. But I was extremely disappointed when I read "Marriage As It Really Is." Does Dr. Cuber propose a world without marriage? Or a world filled with marriages so thoughtlessly entered into that they are easily broken by frequent divorces?

I doubt that 437 couples is a fair estimate of all married couples. May I suggest that the happy, contented married couples felt no need to discuss their lives with Dr. Cuber and his associate for they had no reason to try to justify their behavior since they felt no guilt.

I'd hate to think that the morals of Americans had declined to such a degree that they could not control their appetites. I hope that in the future *Science Digest* will not accept articles which tend to portray sinful behavior as the norm.

MRS. FRANCES GREVES
Glendale, N.Y.

I was surprised at your Feb. '64 cover, including the quote, "I expect to catch hell." Your magazine does not need to rely on eye-catching covers to attract readers. I frequently use your magazine in my class and encourage students to read it, so the reason for my concern is apparent.

Please include more of your fine articles on the latest scientific progress, especially in the basic sciences.

TOMMY MCCONNELL
Abingdon, Va.

The cover was a combination of *True Story* and *Mad Magazine*.

WILLIAM E. HARPER
Lyon Jr. High School
Cincinnati, Ohio

What Dr. Cuber says about marriage is true, but the percentages he gives are wrong. The reason is that you study what appeals to you, what you can make a study out of, and not the general subject.

For example: Nobody has ever studied me. I am still on my honeymoon. I was married in 1927. My wife is tender, loving, affectionate. It is a joy to be with her. She is my business partner as well as my social partner. I see her all day and all evening. When I meet her on the street as she returns from posting a letter I have the same sensation I had as a boy when I was courting her. We are both over 60, grandparents, and still compatible.

"What a coincidence—you discover fire and I invent the hose!"

Now the interesting thing is I can name a dozen of our friends who think the same way. I have to think hard to find people who do not. I have known a few couples, but not for long. They have a habit of disappearing.

RALPH M. SHAW
Beverly, N.J.

Maria Mayer story

In reading the article "At Home with Maria Mayer" (Feb. '64), I discovered a mistake. Madame Pierre Curie, whose name was Marie, was the winner of the Nobel prize for physics, not Eve, Marie's second daughter, who wrote the famous biography of her celebrated mother, *Madame Curie*. Irene Joliot-Curie was Marie's daughter, not Eve's.

BEN STEWART
Houston, Texas

You stated that Maria Mayer was born in Katowitz, "now a part of East Germany." I would appreciate it very much if you would correct this, because Katowitz (Katowice) is a Polish city and never did belong to Germany except during the occupation.

MRS. BARBARA PICUCHA
Kitimat, B.C.
Canada

Narrower and narrower

Lately *Science Digest* seems to be getting narrower and narrower in subject matter. One would imagine its editors thought there was nothing much of interest in the world except machines and Americans suffering from heart disease or phobias of one kind or another.

What's happening in fascinating archaeological fields all over the globe? And what of Nature's clever gadgets?

E. B. WAYNE
Orewa, New Zealand

Computer poet

Re: Feb. '64 issue, article, "The Poet Is a Computer."

Being no expert in poetry, I cannot claim to know all, but you have to admit the kind of poetry printed by this supposedly marvelous computer is sick, sick, sick. . . .

It is an affront to the senses and only as good as the words fed into the computer. Please tell Clair Phillippy to find another more uplifting group of 130 words.

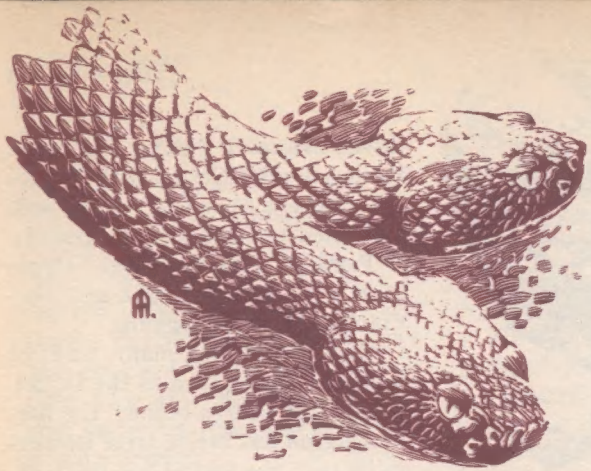
ISABELLA L. ZACHARY
Philadelphia, Pa.

I have just finished reading the poems composed by the RCA 301 and found them to be excellent! Perhaps it is the realization that they were written by a machine that makes them seem so awesome; a machine that has no way of injecting human thought and meaning into the poems, or perhaps it is just the feeling that the machine is talking about a universe that seems to belong to the nonhuman world.

I would like to see more of this space-age poetry in future issues of *Science Digest*. It must certainly make some of today's "dime-a-dozen" poets sit up and take notice.

What will be next? Perhaps they might some day write stories and paint pictures and design structures.

RICHARD A. SWEETSIR
Jacksonville University
Jacksonville, Fla.



Nature's creepiest freaks

Meet the two-headed snake that ate itself and the goldfish with an eye on top of its head. They're just two examples of biology gone berserk by accident and design.

by John Sydney

Two heads aren't necessarily better than one—not when they belong to one snake. A poisonous sand-snake in the snake park at Port Elizabeth, South Africa, had two heads, each on a four-inch long neck. To keep things fair, the keepers would feed a frog to each head. One morning they found that one head had swallowed the other down to where the necks forked. The swallowed head was found to be not quite dead—was rescued and ultimately recovered.

However, the rescued head could not forgive the treatment it had suffered. One morning the two-headed snake was found dead. The outraged head had committed either homicide or suicide, as you may decide.

For some years the New York Zoo had a double headed North American king snake, *Lampropeltis*. Two three-inch long necks forked out from the single body. The snake had two wind pipes and gullets, but, unfortunately, one stomach. Feeding time was a savage battle between the two heads until the keepers hit on the idea of separating the two heads by a piece of cardboard! There was often a serious traffic block where the gullets joined together.

In both these cases, keepers reported that the double-headed snakes lived in a state of frustration and confusion. One head would want to go one way and the other head would want to go another! The same confusion occurs among Siamese tortoise twins which have lived as long as two years in aquariums. One head wants to go forward and the other head wants to go back,

Normal pigeons have twelve tailfeathers. The fancy fantail can have up to 48.

but as each head can only control two of the four legs—on one side of the body—it often happens that legs on one side are thrusting forward while those on the other are straining backwards!

The consequence is that the unhappy tortoise goes round and round in a circle.

Two-headed freaks are not uncommon in nature, but they do not survive very long because they are too handicapped.

Five-legged lambs are born from time to time. So, too, are cats with two faces. Freaks occur fairly frequently among the edible frog, *Rana esculenta,* which are bred in France. Some have an additional limb or extreme malformation of the fore and hind legs. One had fifteen digits instead of the normal five.

There are many man-cultivated freaks—that is, those which man has developed for his delight or amusement. The Chinese developed the telescope-eyed goldfish over three thousand years. The most famous is the Celestial with its protuberant eye set on top of its head and fated to stare forever upwards.

Tumbler pigeons which topple head over heels in flight are other examples of man's juggling.

Man has created many kinds of unusual pigeons such as the fantail, which is of eastern origin. The normal pigeon has twelve large feathers in its tail; the fantail has up to 48. Pouter pigeons, too, have been bred with enlarged crops which they can puff up to balloon proportions.

The other extreme is the so-called African owl, which is a pigeon which has been bred down to the size of a robin. Fancy breeding cannot go much further because the bill in these birds is so short that adults are unable to feed their young. The job has to be handed over to normal pigeon foster parents.

Waltzing mice were popular a few decades ago. They have a defective inner ear, have lost all sense of balance and run around in circles. Other freakish mice, also popular not so long ago, are singing mice which raise their heads and whine continually.

A triumph of human breeding is the Yokohama Cock which has been bred in Japan for 2,500 years. He looks much like a normal cock except for his incredible tail coverts which may be up to 30 feet in length. The spectacular Yokohama Cock has a pretty lean time of it. In order to protect his extravagant tail, he lives tied up to a perch at

Human attendants carry the 30-feet tail of the Yokohama Cock when he is exercised, but for most of his unhappy life he is tied to a perch.

the top of a tall cylindrical cage. Once a day only he is taken down and exercised on an immaculately clean floor while his human attendants carry his train much as they would a bride's!

In the same freak class are the sheep with extremely fat tails which are bred in some parts of the East. In the Middle East you will occasionally see a sheep being driven along the road with its monstrous fat tail mounted on four wheels. The great baggy tail is not intended to be an ornament but is regarded as a prime table delicacy.

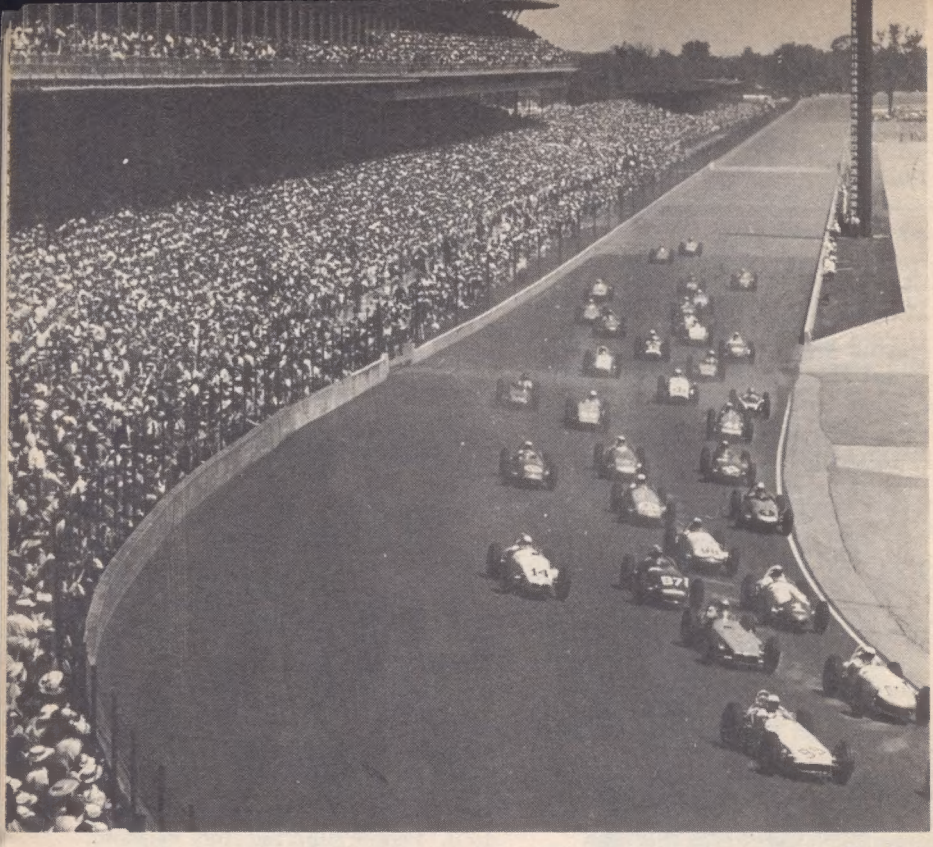
Some pouter pigeons have enlarged crops which they can puff up like a balloon.

Rhinoceros rats are a man-manufactured product in Algeria. They are created by transferring the tip of the tail of the ordinary rat to its nose, where it grows like a small horn.

Siamese twins sometimes occur among human beings. Occasionally, one of a pair develops at the expense of the other. A famous Chinese example of the last century consisted of a normal man who had a tiny little man attached to his breast bone. There was also the Bengalee child who had a small extra head joined crown-to-crown to his own, but with no body attached to it. People suffering from dermoid cysts are sometimes found to have a miniature twin enclosed in a bag of skin inside them.

Biologists can produce Siamese twins in newts and frogs. They do so by partial constriction of the eggs with a fine hair which almost divides the fertilized egg and produces a freak with two heads. Tadpoles with one single eye have been produced by treating the eggs with lithium chloride.

In another even more extraordinary experiment, a biologist transferred the heads of two different species of water beetles. The resulting freaks assumed the habits of their new heads!



Wide World

Thirty-three cars roar into the first turn in the Indianapolis Speedway 500-mile race.

WHO REALLY WINS THE INDIANAPOLIS

The racing car driver is a ball of muscle and courage behind the wheel. But the designers are the real winners at Indianapolis.

by Arturo F. Gonzalez, Jr.

At approximately 4 p.m. on the afternoon of Saturday, May 30, a tiny racing roadster is going to speed past an official frantically waving a checkered flag, take one more triumphant turn around the Indianapolis Speedway and chug happily down victory lane into a throng of wellwishers.

Hero of the hour—the daring racing driver who has steered his speedy little vehicle around wrecks

and through 150 mile-an-hour traffic jams to Indianapolis Speedway victory and a sizable share of the more than $100,000 in prize money available.

Lost somewhere in the cheering throng around the car, however, will be the real winner at Indianapolis—the unsung, unheralded designer of the first place vehicle. Little noticed by the speed-loving public, this man—one of a rare, small breed—has devoted his life to coaxing horsepower and stamina out of metal, rubber and fuel. While Indy's drivers risk their necks out on the track for four short hours at a time, Indy's designers spend the entire year painstakingly blueprinting, assembling and then maintaining the frisky little roadsters which make the runs for glory at Indianapolis, Le Mans, Sebring, Monza and the other major race courses around the world.

Picking the winning designer at Indy this year is a little like hunting for a first prize ticket in the Irish Sweepstakes. But most experts feel it will probably be one of two distinguished automotive craftsmen—either a boyish, crewcut American named A.J. (he has no legal first names) Watson or a distinguished Britisher (who looks a little like David Niven), Colin Chapman, two designers with sharply differing approaches to the Indianapolis car.

Watson represents the best in the traditional approach to Indianapolis design. Along with roadsters by craftsmen like George Salih, Quinn Epperly, Eddie Kuzma and Frank Kurtis, his so-called space frame cars have traditionally begun with a $10,000 Meyer-Drake four-cylinder, 4.2 liter, alcohol-burning Offenhauser engine. Behind and around it is $20,000 more worth of wheels; giant, specially-designed Firestone tires; fuel and oil tanks and the driver's cockpit. The rig weighs in at 1,600 pounds "wet" (filled with fuel) and as many as eighteen of these Watson-designed roadsters may be among the 33 cars which start at Indianapolis when the pace car pulls off the track and the racers hit the first turn at 150 mph. No other designer in recent years has had so many top-notch cars, nor as many winners.

It has taken A.J. Watson over a decade and a half to reach this top rung in the U.S. racing world. A.J. first appeared at Indianapolis in 1948 as a mechanic. He had become interested in racing the year before in Glendale, California, where he had settled after serving with the Air Force as a navigator.

At first, like most men interested in speed, he wanted to be a race driver. While attending Glendale College he built a roadster, took the shiny new job to a track, let it have its head, and suddenly found himself in a hair-raising spin. Watson forthwith decided that he was a pretty good mechanic and would leave the driving to someone with quicker reflexes.

Two years after his first visit to Indianapolis he arrived in style with his first "big" car. It was, of-

America's A. J. Watson represents the best traditional approach to "Indy" racing.

ficially, "The City of Glendale" but it was better known around the pits as "The Pots and Pans Special" since the money for it had come from a hundred or more Glendale residents who had hocked everything, including cooking utensils, to enable Watson to make the trip. Quite frankly, Watson admits today the car also rattled like a collection of pots and pans.

Then came several years of victories with the John Zink racing aggregation and eventually A.J. found it profitable to branch out on his own. Currently he is working for a variety of owners. Each year, each man gives Watson about $50,000 in materials and labor to play with, and the result of Watson's ingenuity and labor is the shiny new car which the owner is able to roll out on the Indianapolis Speedway for the Memorial Day classic. Watson does most of his work in his garage in Glendale, always an immaculate place. He and his few helpers wear cover-alls that seem to remain miraculously spotless, even when the men are laboring over a greasy engine. You'll never see A.J. without a fresh crew hair cut and a clean shave. It has to be this way. Success at Indianapolis, A.J. believes, depends upon perfection. A mote of dust in an important part frightens and offends him.

But A.J. maintains a placid nature none the less: he seems just a college boy ready to step into an 8-oar boat until you notice the gray patches at his temples. These patches come from having watched men whom he has loved and worked with die at the wheels of his automobiles. These gray patches come also from the tremendous strain and responsibility of gearing up a $25,000 piece of machinery to make 800 consecutive left-hand turns on the Indianapolis Speedway in the fastest possible time to win the largest individual prize in the automotive world.

The hallmark of a Watson car is the "ham can," a protruding oil tank on the car's left side which looks suspiciously like something Hormel designed. The innovation is typical Watson. Since all Indianapolis racers turn left in competition only, there's terrific centrifical force pushing the car to the right (left front tires almost never wear out on Indy cars.) Hence Watson reasoned, why not displace the weight of the oil tank as far to the left as possible? Then a second

thought. The car's oil should also be cooled. Why not air-cool it by hanging the tank out in the slipstream?

One season, when this correspondent was hanging around Gasoline Alley (the garage section at Indy), Watson was experimenting with a racing air brake—an extendable flap which the driver would open when he wanted to use air pressure to keep his car down on racing turns. The flap was a flop, but Watson came away satisfied that he had at least experimented a bit with his theory. Race design is a matter of a hundred little experiments like that every season—with an occasional jackpot.

There's little that's secret in the American racing world. Competing mechanics wander into Watson's Gasoline Alley garage at will and a good many of Watson's innovations are now standard equipment on competing vehicles. Watson, similarly, has taken a leaf from the books of others. This year, he and many of his confreres have been examining most closely the designs of Britisher Colin Chapman.

The best of the European designers, a dashing mechanical wizard, Chapman races under the Lotus Team Ltd. colors. His gasoline-burning cars are tiny and light by Indianapolis standards, aerodynamic missiles ideal for the twisting-turning-up-and-down European-style road races but supposedly not strong enough to last through a typical American round-and-round-at-high-speed type race. Or at least

Britain's Colon Chapman (left) has proved European designs can win American races.

that's what scoffers thought until Chapman showed up with two cars at Indianapolis last year and finished a close second and a respectable seventh. His two cars then placed first and third at Milwaukee several weeks later. No foreign racing team has ever done as well on American tracks.

On the Grand Prix circuit, Chapman is currently the monarch of all he surveys. His top driver is the world champion, Jimmy Clark, who won seven of the ten Grand Prix races he entered in 1963—a record which not even the immortal Juan Fangio or Stirling Moss achieved. Chapman's Lotus cars use a 1.5 liter Climax engine in the European Grand Prix races and switch to a souped-up 385 horsepower Ford Fairlane power plant when they come to America. "We're back in big-time racing to stay," a Ford official has said openly. Ford engi-

neers have even designed a brand new 450 horsepower engine for Chapman's 1964 go at Indianapolis. Where Ford goes, General Motors and Chrysler will probably follow—thus ending a rather long boycott of racing by Detroit's Big Three on the grounds that possible racing deaths were poor public relations for automotive firms which were stressing driver safety in their car advertising.

The key word in Chapman's designing dictionary is "monocoque." It's just a fancy Continental way for Chapman to say that his cars' chassis are made of extremely light metal boxes joined together and weighing no more than 1,200 pounds "wet." In the front box is the fuel tank, in the second the driver, in the rear the engine. The boxes are attached to a thin metal base and the wheels independently suspended. "It's a great design if it all holds together," says a rival mechanic. In the early days it didn't and driver Clark lost his chance for a 1962 world championship when a ha-penny bolt on his grass-green roadster gave way during the final race of the season in South Africa.

During the 1963 racing campaign, however, the Lotuses held together beautifully and Chapman suddenly found himself and his cars getting rave notices around the circuit.

When the race is in full swing at Indianapolis, Watson and Chapman will not be sitting back in spectators' seats, their work done, trusting to the fates that their speedsters will come home in the money. Both will be in the pits, huge stopwatches in both hands, timing each lap and watching their cars zip by, looking for the slightest telltale bit of exhaust smoke which might spell the beginning of trouble. Both also boss seven man pit crews which must move fast under pressure, being able to change four automobile tires, pump a full tank of fuel, check the efficiency of a still-revving engine, revive an exhausted driver and polish a windshield—all in less than a minute and in front of 200,000 spectators.

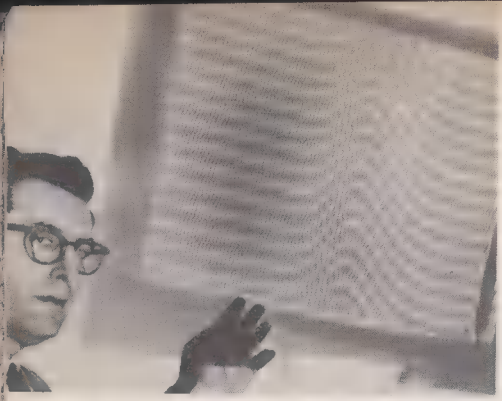
Both Watson and Chapman have to plan and execute race strategy with the coolness of generals under fire, working like greased lightning even though more than $100,000 rides on every command. Both men, in fact, are the quarterbacks of the entire race day effort. The race

Driver Dan Gurney tries out a prototype of a new Chapman-designed Indianapolis car.

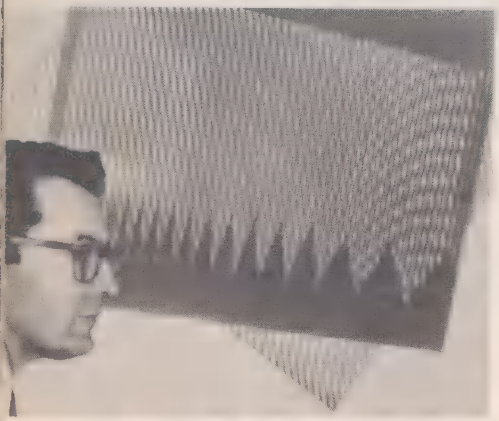
driver himself, has no idea after the second or third lap of how things are going. He's deafened by the roar of his own motor, seared by the 130° heat down on the surface of the track, blinded with the dust tossed up by the car in front of him and battered by the slip stream whipping by. In passing a car, he doesn't know whether he's overtaking a tailender or grabbing the lead. Indianapolis, to the driver, is just 800 consecutive high speed left hand turns and he has no way of knowing — except by instinct — whether he's leading, or out of the running. Some designers have even had their drivers try transistor-lined helmets to establish radio communication, but wind and motor noises block out all reception.

Thus the designer makes racing strategy. The driver is simply a ball of muscle and courage behind the wheel who obeys the designer's instructions relayed to him on a giant blackboard which is held up as he speeds by the pits. This tells him where he stands in the race; who's behind him and by how many seconds—when to come in for a pit stop, fuel and new tires.

Sometime late this coming Memorial Day afternoon, chances are that either Watson or Chapman will be able to chalk up victory congratulations on a blackboard and wave it at his winning driver going by on a last lap. At that moment, all knowledgeable eyes in the pits will be on this happy car designer as he accepts congratulations and endures a lot of jovial back-pounding by well-wishers. Then his car and driver will turn into victory lane to steal the layman's limelight for the next twelve months until Indianapolis time rolls around again.



Dr. Gerald Oster illustrates moire patterns with the aid of a projection device.



A moire pattern is created when you look through two overlapping repetitive figures.

Moires create optical illusions. We see curves or lines where there are none.

Illusions you can use

DID you ever look out through a double window screen and see swirls and curves? If you did, you were looking at a moire pattern, an optical illusion created when you look through two overlapping repetitive figures.

Such illusions are now finding applications in both art and science.

Dr. Gerald Oster of the Polytechnic Institute of Brooklyn believes moire (pronounced mwah-RAY) patterns can represent mathematical solutions to many problems in physics—for instance, in fluid flow, acoustics and electromagnetism. And he feels moire theory can be used to help high school students understand theoretical physics, since complex problems can be solved with only a knowledge of elementary algebra and geometry.

Recently, too, Dr. Oster has been lecturing to artists on how moire theory might be useful to them. In fact, New York's Howard Wise Gallery has exhibited sculptures using moire pattern effects, some of them mobile and others requiring the viewer to move. The results were dizzying. One interested artist: dizzying Salvador Dali.

THE 'SAFE' CIGARETTE

Science is working to make smoking less hazardous. Here's what you should know.

by Bruce H. Frisch

SCIENTISTS are taking many different approaches in the search for a safe cigarette. The ways of making a *safer* cigarette are at hand right now. Maybe there's some (cough) hope.

Underlying all approaches are two basic facts: Tars and nicotine are smoke. The more tar that reaches your lungs, the worse for you. (Nicotine does little harm.)

The Surgeon General's report on smoking and health illustrated the second fact in graphs showing a higher death rate for smokers the more cigarettes they smoke per day, the more they inhale and the longer they smoke.

In the 1950's, Americans switched to filters to cut down on tar. But tar is smoke and tar is flavor. A filter that cut down on tar was simply removing smoke and reducing flavor. The switchers went looking for a brand with both filter and flavor. Soon there were plenty. Cigarette companies put in stronger and stronger tobacco, weaker and weaker filters. Some filter brands delivered more tar than regulars.

Today the relationship between tar and flavor still holds. Almost any degree of tar reduction is available because filters can be made with zero to 100 percent efficiency. Cotton, crepe paper and charcoal have been used. The original Kent Micronite filter was a combination of cotton and asbestos fibers. Later Kent switched to a type found on most other brands—cellulose acetate bought from the same supplier —plus a secret filler. The cellulose acetate fibers can be cut short or long, laid in different directions, crimped, curled and otherwise var-

ied to adjust the filter effectiveness over a wide range.

An even wider range of effectiveness is available in holders. The Aquafilter, it is claimed, removes 98 percent of nicotine and over 70 percent of tar with its wet cotton fibers. The American Medical Association reported these efficiencies for other holders: metal, pipe-type holder, 4-5 percent; paper cylinder, 7 percent; silica gel, 14 percent; holder in which a cigarette is the filter, 41 percent.

In any cigarette, the tobacco itself acts as a filter. As you smoke the cigarette down, trapped nicotine and tar are reburned and inhaled. Studies at Roswell Park Memorial Institute, New York State Department of Health, Buffalo, indicate that the tenth puff may contain 2.5 times the tar in the first puff. The lesson here is: Leave a long butt.

Reducing the tar

Just as cigarette companies chose tobacco with high tar and flavor to cancel the effects of filters, they can choose other strains that have low tar. As far as we know, tobacco can't be bred so that tar from one kind of tobacco is safer than an equal amount of tar from a different type. Dr. Ernest L. Wynder of the Sloan-Kettering Institute checked this out by comparing tar from flue-cured or Virginia tobacco, burley, Maryland and Turkish.

All ways to reduce the tar reaching the lungs can be duplicated simply by smoking fewer cigarettes. The benefits are relative safety, but nothing like complete safety. According to the Surgeon General's report, a smoker between age 40 and 69 who consumes over two packs a day has 2.18 times the chance of dying as nonsmokers in this age group. Even if he cuts down to one to nine cigarettes a day, his chances of dying are still 1.57 times that of nonsmokers.

What he needs is an absolutely safe cigarette. A long step in this direction would be to selectively filter out of the tar all the cancer-causing substances, or carcinogens. Most are concentrated in a tiny fraction amounting to 1.7 percent, so there would be plenty of smoke left over for flavor. Present-day filters show no such selectivity.

Two examples of selective filtration of non-carcinogens have kept hopes alive and attracted more attention than they are worth. Along with smoke particles, you inhale gases such as phenol, hydrogen cyanide, formaldehyde, acrolein and ammonia. They do not cause cancer. They do inhibit the hair-like cilia which sweep foreign particles from the respiratory system.

In tests on five brands at Sloan-Kettering, the common filter material, cellulose acetate, removed 60 to 72 percent of phenol. According to Harvard chemistry professor Louis F. Fieser, who is a member of the committee that prepared the Surgeon General's report, charcoal in the Lark filter was specially designed to remove all these gases.

The whole confusing welter of

A long step toward an absolutely safe cigarette would be to selectively filter out of the tar all of its cancer-causing substances.

filter claims could be avoided if a way could be found to remove carcinogens from tobacco during manufacture. Unfortunately, most carcinogens form during burning. An extract of tobacco is relatively harmless. This means that scientists must first find out what substances, called precursors, turn into carcinogens. Then they can devise ways to remove them. They are still stuck on the first step.

Dr. Wynder suspected that tobacco waxes were precursors. He washed them from a batch of tobacco with a chemical solvent and burned the tobacco to make tar. Although the tar yield was 35 percent below normal, the tar was just as deadly as usual by weight.

Other researchers at the French tobacco monopoly, the Rand Research Corp. in Cleveland, and elsewhere, traced one carcinogen to cigarette paper. Sloan-Kettering put the discovery to a practical test. Tar from cigarettes wrapped in tobacco leaves turned out to be just as powerful in causing cancer as ordinary tar.

Dr. Wynder decided preprocessing was impractical and turned to almost the only remaining part of the smoking act, burning. He has reported some progress in developing a catalyst to block the formation of carcinogens.

Another line of research on burning has caused an actual change in cigarettes. Hotter burning, it was discovered, produces more virulent tar, while tar formed below 700°C is relatively harmless. As a result, there was developed porous paper which leaks cooling air into the cigarette. Whether or not this gives any real benefits has not been proved.

Why a pipe is safer

Pipes and cigars have a lower peak temperature than cigarettes, but they burn hot longer, thus weight for weight, pipe and cigar tar causes more cancer in mice than cigarette tar. Little gets to the lungs, however, because pipe and cigar smoke is so strong, few people inhale. The death rate for pipe and cigar smokers is just slightly higher than for nonsmokers. For this reason, the Surgeon General himself, Dr. Luther Terry, switched from cigarettes to a pipe a year ago.

In desperation, several organizations—the U.S. Department of Agriculture, Roswell Park Memorial Institute and private companies—are looking for a tobacco substitute. They have tried the leaves of papaya, dandelion, swiss chard, spinach and lettuce. At Roswell Park, researchers have puffed leaves of

sugar beet, cabbage and lettuce and plan to go on to catalpa. "The handmade cigarettes we have produced are good," insists the director, Dr. George E. Moore. The researchers spiked some with aromatic spices, and a professor at Los Angeles City College has patented an ersatz blend including clove, cinnamon and apple juice.

All in vain, says the Surgeon General. "Any vegetable material, when burned under the conditions prevailing when tobacco is smoked, will produce hazardous substances. Coal, oil, paper, even spinach, all produce benzo(a)pyrene, a potent cancer-producing substance when burned."

Following the report, a chorus from the labs warned of a long haul ahead in the search for a safe cigarette. Dr. James Webster of the Wesley Memorial Hospital in Chicago expressed the mood when he said: "Even if we spent $1 billion on it, the project would be long and tedious."

What you can do now

• Quit smoking. The earlier you quit, the better. No matter how late you quit, it helps.

• Smoke fewer cigarettes. The lower the daily consumption, the lower the death rate. But even those who smoke less than half a pack a day have a death rate over one and half times that of nonsmokers when they reach the 40-to-69 age group.

• Smoke cigarettes low in tar and nicotine. If you switch to a cigarette with half the tar and nicotine of your present brand, it is like cutting your smoking in half—as long as you don't smoke more of them. Carlton has the lowest reported tar content, 2.5 milligrams per cigarette. Life is next with 5.2 mg per cigarette. Both are extremely low in nicotine. The ten top filter brands averaged 19.4 mg of tar content last summer. But remember, flavor is roughly proportional to tar.

• Use a filter holder. The Aquafilter is reported to trap over 70 percent of tar and 98 percent of nicotine. The next best, which has a cigarette as filter, removes 41 percent of tar.

• Practice restraint. Take fewer puffs, shallower puffs. Leave a longer butt. If lung cancer were a prize, the contest might work this way: For every milligram of tar drawn into the lungs you get a point. The more points you accumulate the better your chance of winning (which means losing). Anything you do to reduce your score helps, but once you get points, you can't get rid of them. There are additional prizes, including heart disease and water-logged lungs.

The lizard that looks like a worm

APPEARANCES can be deceiving. At first glance the creature above looks like an earthworm. It even lives like an earthworm—spending most of its time underground.

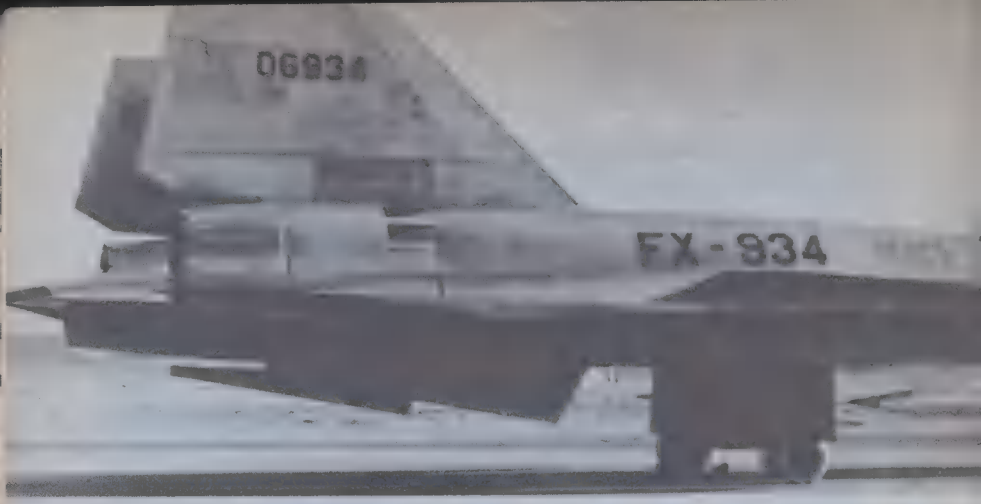
But it's not—it's a reptile, a rare two-footed worm lizard from Baja California. A couple, hopefully, of these reptiles are living in a laboratory at the American Museum of Natural History in New York City.

Charles M. Bogert, Chairman and Curator of the Museum's Department of Herpetology, has not been able to determine the sex of the lizards (for only another worm lizard knows for sure) but he hopes they will, by breeding, prove to be opposites.

The odd reptiles, technically known as *Bipes biporus*, are about five inches long and one quarter of an inch thick. They have orchid-colored segmented bodies that are faintly translucent. Closer examination reveals two small front legs behind an ill-defined head with remnants of eyes represented by a pair of black dots. They are found only in the extreme southern part of the peninsula of Baja California.

Many lizards are limbless and several others have vestiges of limbs, but *Bipes biporus* is one of only three species of lizards that retain front limbs after having lost the pair at the rear. In the evolution of most lizards that have lost limbs, the front legs have been the first to go.

The natural habitat of *Bipes biporus* is underground, in damp sand. When removed to the surface, it promptly thrusts its head back into the sand, compresses its limbs against its body, and shoves itself beneath the surface like an earthworm.



The story

WHEN President Lyndon B. Johnson lifted a corner of the veil of secrecy that has surrounded the development of the supersonic A-11 jet, he said it had an altitude of "more than 70,000 feet." Ten days later, *The New York Times* said it had been "reliably reported" that the A-11 was designed for flights at about 120,000 feet, well out of the class of the ill-fated but effective U-2, which flew at between 90,000 and 100,000 feet.

So, in bits and pieces, the story of the A-11 is becoming known to the American public. The project was started in secret and remained totally secret until about a year and a half before the President's Feb. 29 announcement. At that time, rumors circulated in the aircraft industry that the Lockheed Aircraft Corp. was developing a high-altitude reconnaissance plane.

Reasons for the security are apparent. The plane presumably could fly reconnaissance missions over Communist territory, at an altitude and speed (over 2,000 mph) that would enable it to avoid anti-aircraft missiles of the type that brought down Francis Gary Powers' U-2, in 1960. Already there have been rumors, denied by the Government, that the plane has been used over the Soviet Union. Many Washington correspondents are guessing that the A-11 was developed for, and by, the Central Intelligence Agency.

But hopefully, the A-11 will be much more than a spy plane, or even a long range interceptor. The President stated, "The development of a supersonic commercial transport aircraft will also be greatly assisted by the lessons learned from this A-11 program."

This was no mere sweetening. There has been a good deal of skepticism concerning the U.S. effort to build a supersonic transport to compete with similar British-French and

of the A-11

Russian planes now under development (see "SST—Aviation's Big Leap in the Dark," *Science Digest*, Feb. '64). The A-11 itself couldn't be modified into a passenger plane, but knowledge gained in the design of the powerplant and metals needed for the contemplated speeds may put the U.S. farther ahead in the race than anyone had previously suspected.

Aeronautical engineers have noted similarities between the A-11 and a supersonic transport design previously submitted by Lockheed. Both have the "double delta" wing which Lockheed feels gives each excellent controllability at supersonic speeds and at landing approach speeds of about 140 knots. Another similarity is in the Pratt & Whitney J-58 turbojet engines. The A-11 uses a pair, each with about 32,000 pounds thrust. A supersonic airliner would need four engines with 50,000-pound thrust. An advanced version of the J-58 reportedly can produce that much power.

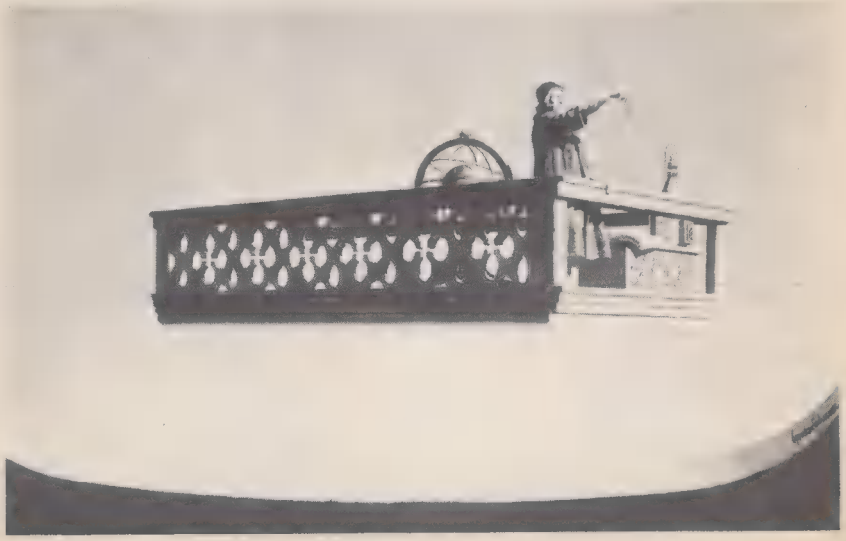
The dimensions of the plane were not revealed, but the President did mention one of the most important developments that made the plane possible. That "has been," he said. "the mastery of the metallurgy and fabrication of titanium metal."

The high speeds of the new plane could virtually melt the metals now in use. In 1950, titanium was hailed as a miracle metal for the aircraft industry, but 10 years later it was called "the greatest fiasco in metallurgical history." Though strong, light and heat-resisting, it was thought, before the A-11, to be too difficult to work and too expensive to be used widely.

Right now, there is still a bookful of unanswered questions about the A-11, but one thing is sure: The plane will have an important impact on future aviation, both military and commercial.

WORLD'S FAIR

Primitive man



Renaissance man

Modern man

18-minute history of man

FIRST, man, naked, low of brow, piercing a boar with spear for food. Then man, taking the measure of the stars to find his place in the universe. Finally, man, with ever open eye, probing all existence, seeking every cause.

Those are three glimpses of the story of man's triumph over adversity as told in The Travelers pavilion at the newly-opened New York World's Fair.

Altogether, 13 elaborate dioramas tell the story of "The Triumph of Man," as the exhibit is called. In three-dimensional "pictures" up to 30 feet wide and 15 feet deep, the dioramas use special lighting, sound effects and animation to create the illusion that the viewer is actually inside the scene which is before him.

Besides the discoveries of Copernicus (see Renaissance Man), the display unfolds the history of man's progress with scenes depicting Roman civilization, early Christianity, the voyages of Columbus and the westward march of American pioneers.

It takes an 18-minute tour to tell the story of man. Wistful about what had to be left out is Dr. Harry L. Shapiro, chairman of the Department of Anthropology at the American Museum of Natural History, who served as consultant. But he's satisfied that the diorama details are as exact as possible, though "I live in fear that some 'expert' will find a tiny mistake somewhere."

SCIENCE LOOKS AT BEATLEMANIA

by John A. Osmundsen

WHAT is the Beatle uproar all about?

How, people are asking, could four mop-headed, neo-Edwardian-attired, Liverpudlian-accented, guitarplaying, drum-beating "little boys" from across the ocean come here and attract the immense amount of attention they did by stomping and hollering out songs in a musical idiom that is distinctly American?

Ask a typical Beatle fan—female, in her early teens—and she will say it is because:

"They're so keee-ooot."

Or because:

"They're different! They're just so different!"

Adults, some but not all of whom view the Beatles somewhat cynically, are likely to say that the craze sprang from the high-powered promotion that the performers received.

Social scientists agree with both the adult and teen-age views but note that, no matter how effective the promotion of the Beatles may have been, the public response to them was real and deserves a deeper probe for its origins within the needs and attitudes of the Beatlemaniac himself.

Practically every standard explanation in the book has been offered by psychologists and psychiatrists

CBS Television Network

The Beatles arrive in U.S. to appear on the Ed Sullivan Show. For results, see below.

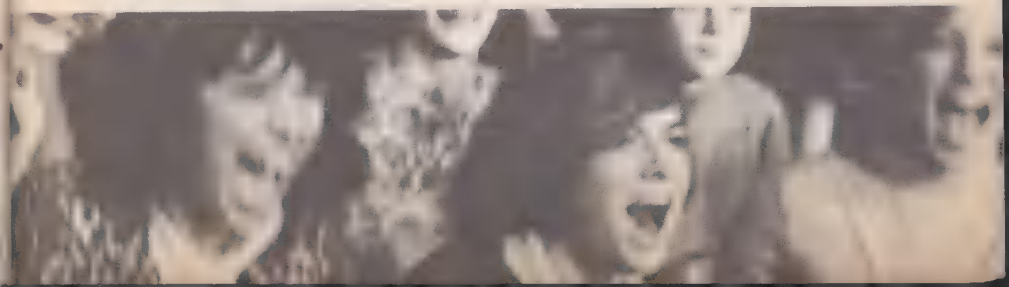
for Beatlemania. The Beatles, these analyses say, serve as symbols of:

- Adolescent revolt against parental authority. Status that comes from belonging to a group, in this case, of other Beatlemaniacs.
- Sex, both from the supposed erotic nature of the Beatles' music and the way they perform it and from the appeal they seem to have to the "mother instinct."
- Success by persons who are seen as fellow teen-agers (although none of the Beatles are under 21) and as underdogs who came from the wrong side of the tracks and have made good.
- The frenetically felt urgency for having a good time and living life fast in an uncertain world that is plagued with mortal dangers.

Any or all of those explanations of Beatlemania may be more or less correct, in the opinion of a young Barnard College sociologist whose shoulder-length brown hair tends to flop Veronica Lake-fashion over one eye and who remembers attending a "Hit Parade" broadcast in the midst of girls her own age who shrieked and swooned into their bobby socks over Frank Sinatra.

But she thinks the most important answers to the Beatlemania question run much deeper than sex and status. She believes, moreover, that the phenomenon could serve as an ideal subject for a sociological study of the dynamics of fads and crazes and of social stratification.

CBS Television Network



The sociologist's name is Renee Claire Fox. She is an assistant professor of sociology at Barnard, but her researches have taken her as far away in the last two years as Belgium, where she studied the conduct of medical research and the scientists who do it, and the Congo.

Although those experiences do not qualify her as an expert on such matters as Beatlemania, her general sociological training has given her insight into the kinds of questions that could be asked about such a phenomenon.

In fact, she has developed a theory to explain Beatlemania. Dr. Fox's theory is essentially this: The wide range of the Beatles' appeal stems from their personification of many forms of duality that exist in our society.

The Beatles, she says, constitute a treasure trove of such dualities.

For example, she explains, they are male and yet have many feminine characteristics, especially their floppy hairdos. They also play the dual roles of both adults and children. And they appear to be good boys who nevertheless pose as bad ones—London's Teddy-boys.

Much has been made of their poor, lower-class backgrounds in Northern England. Yet they are accepted by the upper crust, having attracted the auspicious attention of the Queen Mother, Princess Margaret, Mrs. Nelson A. Rockefeller and President Johnson, the latter through a statement by former White House Press Secretary Pierre Salinger.

Nor is this all. The Beatles, in their personal appearances, sing and play but seldom can be heard above the shrieks of the audience, and so they almost play the role of mimes. In addition, Dr. Fox observes, the four are both an audience for their own antics and for those of their cavorting, screaming audience, acting, as it were, a play within a play.

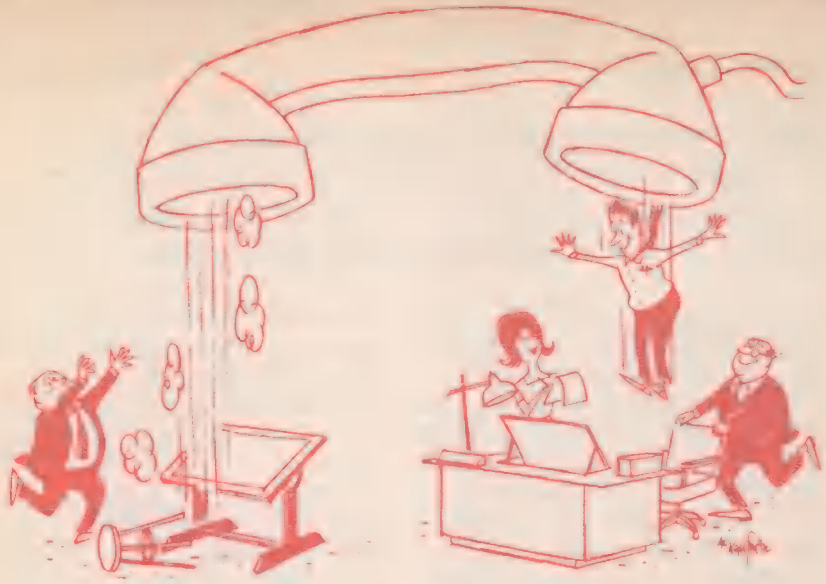
"There is a Chaplinesque quality to their style," Dr. Fox says. "They convey the image of absurd little men in an absurd, big world, bewildered but bemused by it at the same time."

The Barnard social scientist observes that here, as in England, the appeal of the Beatles is not confined to girls in their teens and younger, but spreads to boys and to many adults of both sexes.

She says she thinks that at least part of the attraction for adults lies in the Beatles's realistic attitudes toward their own success and their eventual eclipse.

In the Beatles, Dr. Fox believes, people see four basically nice young boys who project some of the same contradictions that exist in many Americans, who are having a wonderful time at the acceptable expense of both themselves and their audiences, who have expressed their gratitude for this fling and who have promised a graceful adjustment to the time when the party is over.

It would seem, to paraphrase W. C. Fields, that someone who possesses all those qualities can't be all bad, no matter what some parents have been driven to think.



How to steal an engineer

There was a time when a man had to pound the pavements to get a job. Today a good engineer will find himself pursued by a new brand of recruiter.

by James H. York

"HELLO, Mr. Smith? My name is Jones. I am calling to find out where in the world you would like to work and also what salary would induce you to change."

These are not the exact words of the telephone technical recruiter but they spell out his message.

The shortage of good engineers, mathematicians, and physicists has developed a new breed of technical recruiter. Now finally, when even the politicians are admitting that automation is throwing more people out of work than it can presently create new jobs for—the tree of advancing technology, with its main limb of automation, is draining dry every source of trained technical workers available.

Presently, our tree and Russia's tree are pretty well matched in their race toward the heavens. Enterprising businessmen are nourishing our tree and advancing payscales of engineers and scientists by their establishment of engineering search agencies. Important for more than taking good engineers out of conventional ruts, these agencies are providing the aerospace, computer, and electronics industries with the

At a typical recruiting agency, 90 percent of the work is done by phone. In a closed area in separate booths, recruiters work at the rapid pace of the typical telephone sales "boiler room."

critical specialty skills. Many engineers and scientists in routine jobs are capable of filling vital gaps.

Only ten percent of the work of these recruiting agencies is personal interviews. The other 90 percent is conducted over the telephone. If you entered one of these agencies you would not see the telephone recruiters. In a closed area in separate booths the recruiters work at the rapid pace of the typical telephone sales "boiler room." The nature of the work lends itself to a commission-basis pay structure so that the recruiters work rapidly.

The rapid pace, however, is softened by the professional-fraternal approach. The recruiters are, for the most part, freshly-graduated engineers themselves trying to supplement their starting salaries by working in the evenings and on weekends. Calls are never made before 10 a.m. on weekends and holidays or after 10 p.m. on any night. Gaining the confidence of the prospect is as important.

"This is strictly a non-rock-the-boat operation, Mr. Smith. We contact nobody else, sir, according to your directions and when we do contact you sir, it will be at home."

Gaining rapport with the prospect is not easy. The telephone has become the tool of salesdom if not to sell outright, to gain a foothold. The telephone books are shrinking daily with the growing void of unlisted numbers.

"There are no contractual arrangements whatsoever, Mr. Smith, between you and this agency. Time is the only commodity that you invest, sir, to attend one of our centers."

Talks for hot prospects

"Center" is the term generally used by these agencies to describe a get-together of about ten of the client firms and as many qualified prospects as can be obtained. If there are too many prospects scheduled, those with the lesser experience are interviewed only by the agency itself. The hot prospects are interviewed privately by each of the firms which are interested in that individual's background.

An engineering search agency will not recruit from the ranks of its main clients. The prospect who is dropped for this reason may or may not be told why. Because clients sometimes wish to remain anonymous, a more polite, kinder version of the old chestnut about who is to call whom is used.

Some of the main clients hire the

James H. York is a senior technical writer in engineering, and was a telephone technical recruiter for two months.

agency to find a particular man for a particular slot. The telephone technical recruiter may spend 20 hours on the phone calling half of the names in the file before scheduling a man for an interview. About 75 percent of these interviews are successful and everybody is happy except the former employer. If a man's name is in the files of one of these agencies, eventually he will be called.

A thumbnail sketch of the individual's background is obtained on first contact and this sketch goes into the files. In the privacy of a home telephone conversation, most people are generous with personal information, even salary information. Even if they are not, the interviewer is more interested in the salary the prospect is looking for. A bigger problem for the interviewer is finding out when the traveling husband is going to return. Wives, for the most part, are concerned that an unknown voice over the phone might be more interested in them than in their husbands. In this case, the interviewer spells out his and the agency's names slowly and says he will call again tomorrow night anyway.

The question most frequently asked by the prospect is "Where did you get my name?" The truth is that the name probably was on some kind of list—technical magazine delivery, professional journal contributor, or even company telephone. A small percentage of names are referals and this is the prescribed answer to the prospect.

"Mr. Jones, we probably received your name as a referal from one of your friends. I am not sure sir. Your name is on a list given to me. You realize sir, just as I must guarantee your privacy, I must respect your friend's confidence. It would help us, sir, to quote a mutual friend but we rarely receive permission to do so."

Who would have thought, back in the thirties, or forties, or even fifties, that employers would have to go to such extremes to find qualified employees? "Mr. Smith, this is a service offered to you, by our clients, through us."

Never too young

WHEN should infant health care start? Before the baby is conceived, Dr. Carlo Sirtori told the third Congress of the Italian Academy of Forensic Medicine in New York.

"I have always found it disconcerting that so important an event as conception should be allowed to take place without any specific prior care considering that its effects may last in some cases for centuries," he said.

Dr. Sirtori was not suggesting that conception can be pinpointed exactly. What he did favor was a health program for young couples who were planning to have children. "Although spermatozoon and ovum are microscopic," Dr. Sirtori pointed out, "when they are affected, the damage will affect all the billions of cells in the adult human body."

The 40-knot sailboat

It looks as if it is made out of old coat hangers and tongue depressors. Nothing about it gives any assurance it will float, never mind go three times as fast as a quarter-million-dollar America's Cup racer or sixty percent swifter than the fashionable and fast catamaran.

Its inventor, Bernard Smith, Chief Engineer of the Bureau of Naval Weapons, packs the equations that say it can into *The 40-Knot Sailboat* (Grosset & Dunlap, Inc., New York, 140 pp., $10). He has named his sailboat the aerohydrofoil. To design it, Smith threw away the book of marine architectural conventions and went back to basic principles. The result is like a vector diagram carved in wood. He ditched the hull, got rid of the keel, eliminated the sail and dumped the ballast. He ended up with a wing stuck in the air and three stubby wings thrust into the water. The airfoil provides forward push, the hydrofoils, vertical lift. Since each is angled slightly, the airfoil also contributes some lift and the hydrofoils counteract the wind's efforts to tip the boat and push it sideways. In the stiffest breeze, the aerohydrofoil will sit perfectly erect while it scoots along up to more than twice the speed of the wind.

Backwards and forwards

When it comes time to return home, Smith won't turn around; he will simply throw his aerohydrofoil into reverse, a trick he learned from the Marianas Islanders' flying proa.

Here's a tip on how to better understand how all this works: Start with the final chapter on basic sailing principles. In his design, Smith may have put first things first, but in his book, he has put first things last.—*B. F.*

Alcoholism controversy

National Council on Alcoholism

A hot debate is raging over a British study indicating that some reformed alcoholics can become normal drinkers

by Sidney Katz

ALCOHOLISM experts have always maintained, until recently, that there is no such thing as a "cured" alcoholic. The slogan, "Once an alcoholic, always an alcoholic," was presented as an inviolable principle. They claimed that the alcoholic must remain absolutely and completely dry for the remainder of his life.

This certitude about the alcoholic and the nature of his disease has now been shattered by a careful study carried out by a distinguished English authority on alcoholism. Not long ago, Dr. D. L. Davies, Dean of the Institute of Psychiatry at London's Maudsley Hospital, began wondering how his discharged alcoholic patients were making out in life. So he tracked down 93 of them who had been out of the hospital anywhere from seven to eleven years. It was then that he made an amazing discovery: at least seven of them had developed into normal, social drinkers. No matter what criteria were applied, they were completely civilized drinkers. There was no evidence that they ever became inebriated; their relationship with their wives was harmonious and they were rated highly by their employers. After carefully re-checking his results, Dr. Davies wrote a paper for the *Quarterly Journal of Alcohol Studies* (Rutgers University) in

which he concluded that some alcoholics *can* be cured and that "the generally accepted view that no alcohol addict can ever drink again normally should be modified."

What is an alcoholic?

A lively controversy is now raging among alcoholism experts throughout the world as the result of Dr. Davies' highly unorthodox paper. Many authorities are frankly skeptical about his findings. A highly respected figure, Dr. Ruth Fox of the National Council of Alcoholism, New York, says, "My own practice covers hundreds of alcoholics. . . . I do not know of a single patient of mine who has been able to resume normal drinking." Dr. P. H. Esser of Haarlem, The Netherlands, concedes that Dr. Davies' seven patients certainly suffered from severe, habitual, excessive drinking but doubts that they were true "alcohol addicts." Genuine alarm is expressed by a Seattle psychiatrist, Dr. Frederick Lemere, who foresees countless tragedies if alcoholics and their therapists, in large numbers, take Dr. Davies seriously. As a matter of fact, he strongly advocates changing the definition of an alcoholic to specify that he's an individual who is incapable of drinking in a normal manner. "Those few patients who run counter to this rule should be classified as 'pseudo-alcoholics,' " he says. Dr. Marvin A. Block of Buffalo regards Dr. Davies' conclusions as being fraught with danger and states that, in the best interests of his alcoholic patients, he will urge them never to deviate from "total and permanent abstinence."

But not all the people who have commented on Dr. Davies' conclusions are skeptics and doubters. Anyone with wide experience in the field will have seen cases of alcoholics who have become social drinkers "to refute the generally held belief," says Dr. John D. Armstrong of the Alcohol and Addiction Research Foundation, Toronto. One of the British physician's strongest supporters is Dr. Melvin L. Selzer of the Neuropsychiatric Institute, University of Michigan. He recalls that, back in 1957, he published a paper which followed up the fortunes of 83 alcoholics who had been discharged from treatment five years previously. "Thirteen of them," says Selzer, "had become social drinkers." The agency that provided the funds for this study was so embarrassed by this finding that, say Selzer, "they virtually ordered us to omit it from our report." In Selzer's view, his and Davies' research "warrants a second look at the long-cherished theory that no alcoholic can ever become a moderate drinker."

Drs. J. Norvig and B. Neilsen of Denmark would strongly agree. A follow-up study of 221 Danish alcoholics revealed that "some drink occasionally, although not more than

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Sidney Katz, an editor of MacLean's magazine in Canada, holds degrees in social sciences, is a master of social work (in psychiatry) and attended the summer session of the Yale School of Alcohol Studies.

The British study is supported by a Michigan doctor who followed up the cases of 83 former alcoholics; 13 of them became social drinkers.

is compatible with attention to their work and, in most cases, with preservation of their social status." Another piece of evidence that corroborates Dr. Davies' claim is a lengthy case history of a patient, published by an American psychiatrist, Dr. J. E. Shea. He writes: "The patient drank to violent excess for more than twenty years," then abstained for five years, "and since then, for five years, has been a sparing, controlled drinker."

No news may be good news

It is possible that many, many more such cases exist. A reluctance on the part of individual doctors to publicly describe such highly unorthodox histories is one reason they may never come to light. Another reason, suggested by Dr. Martha Brunner-Orne of Boston's New England Hospital, is that lack of thorough follow-up studies is the "weakest link" in alcoholism research. Doctors are most likely to maintain contact with those who can't resist the bottle and go on a binge again. "But the ones we don't hear from are the alcoholics who succeed in drinking moderately. It may be a case of 'no news' being 'good news,'" says Dr. Brunner-Orne.

Most of the critics who have attacked Dr. Davies' now-famous paper, *Normal Drinking in Recovered Alcohol Addicts*, make the charge that his seven former patients who have returned to casual drinking never were *bona fide* alcoholics. Dr. Davies rejects this argument. "They were confirmed alcoholics," he says. "Loss of control over drinking had occurred. They were true addicts, not merely inebriates." One patient was a truck driver, who, for several years had consumed, each day, a bottle of whiskey and twenty-four bottles of ale. Another had been drinking vast quantities for nine years when he appeared at the Maudsley Hospital for treatment. During the previous four years, he had suffered several attacks of the D.T.'s. He was so confused that he was unable to hang on to his job with a large corporation where he was a cashier. These two men were typical of the seven who had now achieved normal drinking. Furthermore, says Dr. Davies, since all seven had now been drinking moderately for several years, it was highly improbable that they would relapse into uncontrolled drinking. Therefore, says Dr. Davies, there's evidence that complete cures do occur in alcoholism. Aware that misinterpretation of his findings might very well spell doom for many "dry" alcoholics, Dr. Davies points out, "I do not deny that the majority of al-

cohol addicts are incapable of achieving normal drinking. All patients should be told to aim at total abstinence."

The numerous and varied pros and cons evoked by Dr. Davies' paper underline both the complex nature of the disease known as "alcoholism" and our present incomplete state of knowledge about it. Much of the debate has appeared —and is appearing—in the *Quarterly Journal of Studies on Alcohol* —a traditional forum for new ideas in the field of alcoholism.

What causes a drinker?

Dr. Harry M. Tiebout, an alcoholism authority from Greenwich, Conn., says, after reviewing the Davies study, "The concept of irreversibility is basically sound. It may need refining; it should not be abandoned." His explanation of why Davies' seven patients became temperate is this: Some people become excessive drinkers largely because of some external factors in their lives. Drinking may be triggered off and perpetuated by a death, an economic reverse or an emotional crisis. For some, the catalyst may even be a personal triumph resulting in great elation and euphoria. At such times, the individual will be compelled to drink; when the external factors disappear, so will the compulsion "disappear and not start up afresh with the intake of alcohol." In other words, Dr. Tiebout says, the compulsion to drink is neither fixed nor constant. "At times, it loses its steam or force, thereby making it possible for the individual to drink normally." Dr. Tiebout would like the profession to recognize the on-again-off-again nature of the compulsion to drink in a small proportion of alcoholics. "As for my own patients," he says, "I will continue on the assumption that alcoholics cannot drink again."

Like most other physicians who have worked with alcoholics for many years, Dr. Tiebout confesses to a strong, built-in resistance to changing his views on the irreversibility of alcoholism. Why should this be so? Dr. Melvin Selzer, referred to earlier as a supporter of Dr. Davies, speculates that many of the therapists working in the field of alcoholism are alcoholics themselves and that it may be difficult "for the alcoholic who must remain dry to accept the idea that others can recover and drink socially. To hear of the success of others may be frustrating and these workers prefer not to hear about it. Granted that experimentation will yield discouraging relapses in most instances, this is not sufficient excuse for prejudiced persons to vilify the truth."

Who can drink, and who can't

A more obvious explanation is that alcoholism experts are afraid of the consequences of allowing alcoholics to return to drinking. We still have no way of identifying the small proportion of problem drinkers who can become normal drinkers.

A Buffalo physician, Dr. Marvin

There is no way of telling how many former alcoholics can become normal drinkers, so experts are afraid to let them drink again.

A. Block, has two interesting explanations for the unexpected return of Dr. Davies' seven patients to moderate drinking. The first is that the temperament and attitudes of Englishmen differ radically from those of North Americans; hence, it is quite conceivable that in the English personality, alcoholism is reversible. Secondly, Dr. Block suggests that the seven patients have been blessed with a medical miracle, namely the phenomenon of the "spontaneous recovery." "It is not rare," explains Dr. Block, "to have a spontaneous recovery from severe illnesses without the medical profession knowing the cause of either the illness or its solution. Proven cases of cancer have disappeared without medical help or treatment." This, says Dr. Block, might happen—however rarely—with alcoholics.

While Dr. Israel Zwerling of Einstein College of Medicine, Yeshiva University, New York, has never had an alcoholic patient who resumed normal drinking, he has encountered men and women who have been able to "manage" their alcoholism. One of his most memorable cases was a gifted novelist whose emotional life had been disentangled to a considerable extent after psychiatric treatment. "Since therapy," says Dr. Zwerling, "he has abstained completely from drinking during periods of writing. When he has sent corrected galleys back to the publisher and is waiting for a new book to come out . . . he will go on a two- or three-day drinking bout with careful controls built in to prevent its extension beyond the predetermined period of time."

Perhaps the most revolutionary idea presented in the controversy belongs to Dr. Hiroshi Mukasa, director of an alcoholism clinic in Kurume, Japan. Dr. Mukasa holds the highly unorthodox view that *all* alcoholics can and should continue to drink moderately. Accordingly, each day he gives them a small therapeutic dose of cyanamide, followed by two drinks of their favorite alcoholic beverage. The action of the drug is such that the patient feels no discomfort after exactly two drinks. If he drinks more, he experiences a highly unpleasant sensation, the result of the cyanamide reacting with the alcohol. Dr. Mukasa claims to have treated 261 patients successfully so far.

Report from Norway

"The tidal wave of discussion about Dr. Davies' article has reached Scandinavia," says Dr. Th. Kjølstad of Bjornebekk Kursted, Norway, who sheds new light on what constitutes "loss of control" in the drink-

ing behavior of the alcoholic. A surprisingly large number of alcoholics actually can take a drink or two and not lose control, says the Norwegian physician. This usually happens, however, when he casually joins an acquaintance for a friendly drink or he drinks to prove, specifically, that he can control his consumption of alcohol. However, if the alcoholic decided in advance that he's going on a binge, even the smallest jigger of whiskey will cause him to lose control. "He's actually lost control before taking the drink," says Dr. Kjølstad. "He has decided to drink and uses the loss of control only as an explanation to relieve his guilt feelings and placate those around him."

Telling who can drink

If Dr. Davies' findings are to be of wide practical value, the task now remains for our medical scientists to devise a foolproof method of selecting the minority of alcoholics who are capable of becoming safe, controlled drinkers. Until then, in the name of common sense and decency, nobody should advise the average "dry" alcoholic to have a beer or a cocktail.

★ ★ ★ ★

Watching all the girls go by

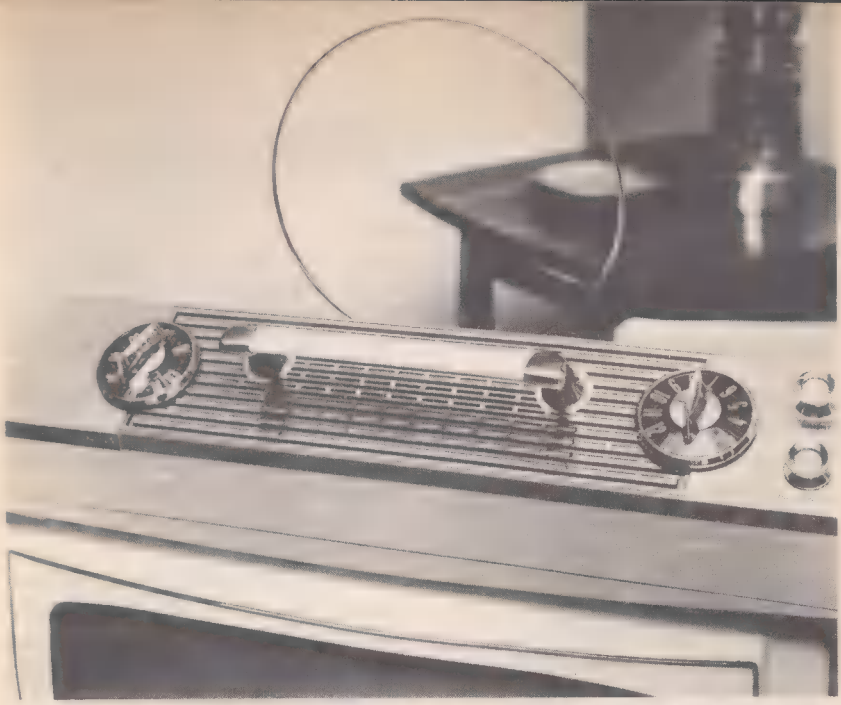
COUNTING drone bees waiting for a queen bee led Dr. Norman Gary to another discovery. To take a count of the drone bees, he was using a transparent plastic trap carried aloft by a balloon and baited with a chemical bee sex attractant. Dr. Gary found out that the drones don't just wait for a queen bee on any old street corner.

"They choose specific congregation areas," he reports. On sunny afternoons, a male bee heads for a favorite drone hangout and circles for a few minutes with others—from his hive or from a nearby area—on the prowl. He averages three such trips per afternoon, returning home between times to fill up on honey—because this sort of thing takes a lot of energy.

In this way, many drones are on hand at a specific location in case a queen bee should arrive. It's a form of biological insurance. The waiting drones usually fly between 30 and 150 feet high. By marking and releasing those that are trapped, Dr. Gary and his research team have traced them back to their hives. A drone often returns to the same meeting spot, they have found.

What makes him pick that particular spot? Distance is important. Most drones stay close to home. But other, so far unknown, reasons also make certain spots attractive to questing males.

Where will all this lead? Dr. Gary's trapping technique may some day be used to locate drone congregation areas close to commercial queen-raising operations, and also to survey the drone population visiting them. This could lead to better control of natural mating, and even to better breeds of bees. In California, production of queens is an important industry.



Starting this month, all TV sets will have to have UHF tuners (left dial). Many, like this RCA model, will also have antennas designed to pick up UHF channels.

Big change in TV

THE biggest change in TV since the introduction of color goes into effect April 30.

Federal legislation requires that all sets manufactured after that date must be equipped to receive 70 Ultra High Frequency channels numbered 14 through 83. Currently, sets need only receive the Very High Frequency channels numbered 2 through 13.

There are already more than 110 UHF stations in the United States, and more than 525 VHF stations. But the VHF spectrum has room for only about 650 stations, while the UHF spectrum can accommodate about 3,000.

The change won't make any big difference in the appearance of the new sets. The only visible changes will be the addition of a second channel selector marked UHF, according to Clyde Hoyt, staff engineer for RCA Victor, and a position marked U on the familiar selection knob. To tune in a UHF channel you first turn the familiar knob to U and then turn the UHF knob to whichever UHF station you desire. One feature of the UHF knob—it doesn't click but instead dials similar to a radio.

Picture reception on UHF channels can be as good as the VHF picture in areas where reception conditions are favorable. Attached UHF antennas will be supplied with many

portable sets. In poor reception areas you may have to get an outdoor UHF antenna.

UHF sets will probably cost about $20 more than the same set in a VHF model, but this will vary, and there may not even be a price factor in certain cases, some manufacturers indicate.

How about pre-April 30 sets? Can they be converted to UHF? In many cases they can. Some models can be converted to UHF by having a UHF tuner installed.

But don't try to tune in channel 73 quite yet. The ruling requiring UHF in sets was passed to stimulate the use of these channels, but industry experts believe it will be five to ten years before a large number of these channels are being used.

The reason is that most people keep their TV sets from six to eight years. They are not expected to rush out and buy new ones just because they have UHF on them. There won't be enough UHF sets in circulation for five years or more to make extensive programming on such channels worthwhile. Color TV, however, should help the spread of UHF. If the public begins buying new color sets they will get UHF as an extra bonus.

What will UHF channels mean to the viewer? In the many cities where there are only two channels available, the third network might be able to use a UHF channel, thus offering viewers a larger choice of network shows. Channels could also be used for special broadcasts, like local sporting events. UHF might even bring the development of some cultural channels, similar to the good music stations on FM radio. Such stations would present discussions, serious drama shows imported from European television stations, and other programs which would not have mass network appeal.

But mainly UHF, like FM, will probably be used to supplement and expand regular network programming. Especially outside of the really large cities.

★ ★ ★ ★

A cure for trichinosis?

A GALVESTON hospital patient is believed to have been cured of trichinosis, the first such cure ever reported.

The woman, suffering from worms after eating uncooked pork, was given thiabendazole, a new broad spectrum drug, it was reported in the *Journal of the American Medical Association*. Limited to investigational use in humans, the drug had already been proved effective against trichinosis in animals. It had been used against other intestinal parasites in human beings.

On admission to the hospital, the patient could not walk unaided and had generalized muscle pain and tenderness. Thiabendazole was administered on the sixth hospital day, and within 48 hours she showed marked improvement. Seven days after the drug therapy was begun, the woman was discharged with normal strength and no muscle pain or tenderness. The only side effect was mild, transient dizziness.

YOUR SCIENCE ABC's

Levers

LABOR-SAVING DEVICES

HEAVY flagstones can be lifted by means of a crowbar. This is an example of the use of a simple machine called the lever (diagram 1). The lever is pulled down by a force, called the effort, and it turns about a point called the fulcrum. The weight to be lifted, the flagstone, is called the load. Archimedes (287-212 B.C.) knew the principle of the lever. The crowbar as used above has the fulcrum between the load and the effort. Such levers are said to be of the "first order."

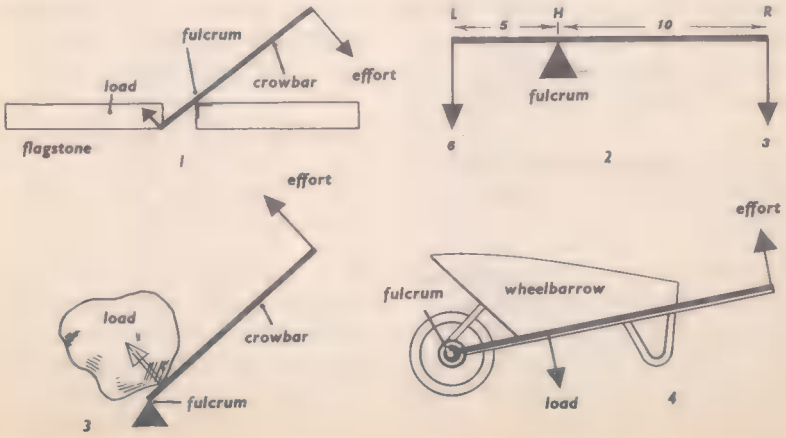
The turning effect or "moment" of a force, or weight, is measured by multiplying the force by its distance from the support, or fulcrum. If we apply this to the example in diagram 2, we find that the

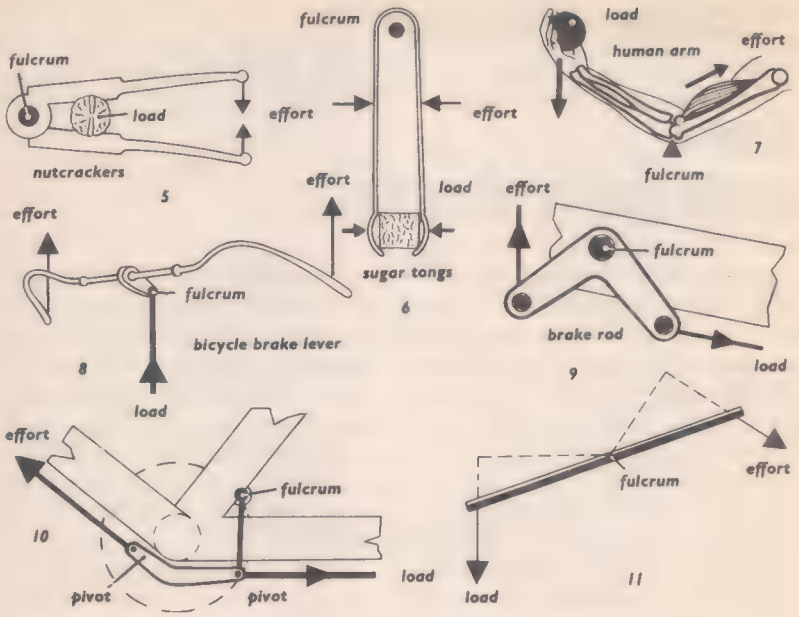
moment (R.H.) = weight × distance from fulcrum = 3 pounds × 10 feet = 30 pounds feet

moment (L.H.) = weight × distance from fulcrum = 6 pounds × 5 feet = 30 pounds feet

If we look into this more closely we see quite readily that the small weight has the same moment as the large weight about the fulcrum, because of its greater distance away

Levers





from it. As it is double the distance, the leverage is twice what it would be at 5 feet and so it can lift the large weight which is twice its own weight.

The crowbar may be used to lift a door off its hinges, or to raise a stone with the fulcrum right at the end on the ground (diagram 3). In these circumstances, it is a lever of the "second order," for the load to be lifted is between the fulcrum and the effort; in this example the ground is the fulcrum. There are a number of levers of the second order in common use, like the wheelbarrow and nutcracker (diagrams 4, 5).

There is still another or "third order" of levers in which the effort comes between the fulcrum and the load. A simple example of this is a pair of sugar tongs (diagram 6) or coal tongs. The human arm is a lever of the third order. Here, the load is the weight in the hand, and the effort is made by the arm muscle, and the fulcrum is the bone joint (diagram 7). An enormous effort is needed by the muscle to raise the load of 100 pounds.

Levers in the bicycle

Levers are of the utmost value in many kinds of machines. Good examples of these are to be found in the ordinary bicycle hand brake (diagram 8). The effort is made upwards on the brake handle, and the fulcrum is the bearing about which this handle turns. You will notice that this is a lever of the second or-

der, because the load (brake rod) comes between the fulcrum (axis of brake handles) and the effort (at end of brake handles). Now follow the brake rod down. Another lever of the first order is on the bar leading down to the pedal (diagram 9); the crankshaft changes the direction of the pulling force. This can be applied to yet another lever of the second order. This lever is connected directly to the back wheel brake shoes (diagram 10). The bicycle brake is a very good example of how levers are employed in machines. The effort applied at the hand brake here is less than the force, or load applied to the brake shoes. If we look again at the diagrams of levers of the first and second order we will see the reason for this. When efforts are further from the fulcrum than the load, they are less in amount than the load. In levers of the third order, efforts must always be greater than the load, for they are made nearer the fulcrum.

Losers by a tail?

ALL the animals were in the ark—the toads and frogs, the lions and dogs, the badgers, foxes, moles, and voles. It was starting to pour, and 600-year-old Noah was getting impatient. Where were those cats?

They finally appeared, ambling leisurely through the wet grass, stopping now and then to shake a dainty paw. As soon as they entered the ark, Noah slammed the door—too hard and too soon. That, if legend be believed, is how the Isle of Man's rumpies and stumpies, known elsewhere as Manx cats, lost their tails.

Manx cat fanciers are fearful of this breed's eventual disappearance, the National Geographic Society reports. Not that the cats will become extinct, but by mingling with their common, tailed relatives they may lose their identity and gain a tail.

To keep rumpies going, an Isle of Man Manx Cat Association has been formed and the alarmed government of the isle in the Irish Sea has established an experimental farm.

Manx cats are called rumpies or stumpies according to their degree of taillessness. Rumpies, which have no tails at all, are considered more valuable than stumpies, with their rudimentary queue.

Also characteristic of Manx cats are their short forelegs and unusually long hind legs. This feature gives the cats a peculiar hopping gait that prompted another fanciful tale: The breed is the consequence of a cat-rabbit mismatch.

Reproduction of Manx cats is somewhat haphazard. The same litter is likely to contain tailless and tailed varieties and color may differ. Breeders have found that inbreeding produces weak kittens after three generations. After four, the kittens are stillborn. Manx have to be mated with ordinary cats to keep the strain strong. Tailless cats have long existed in other parts of the world, but how they reached the Isle of Man remains obscure.

Earthmen are the only men

ADMITTING he may seem to be something of a spoilsport, a Harvard biologist reaches the following conclusions in a book just published:

"1. There are certainly no humanoids (living beings with intelligence comparable to men's) elsewhere in the solar system.

"2. There is probably no extraterrestrial life in our solar system, but the possibility is not wholly excluded as regards Mars.

"3. There probably are forms of life on other planetary systems somewhere in the universe, but if so it is unlikely that we can learn anything whatever about them, even as to the bare fact of their real existence.

"4. It is extremely improbable that such forms of life include humanoids, and apparently as near as impossible as does not matter that we could ever communicate with them in a meaningful and useful way if they did exist."

The biologist is George Gaylord Simpson, who calls himself "an evolutionary biologist and systematist." He explains his conclusions in a chapter, recently published by *Science*, of his book *This View of Life: The World of an Evolutionist* (Harcourt Brace & World, Inc., New York, $5.95).

He says that the possibility of life elsewhere in the universe has become the object of research by people who are not biologists and who, if they were, would be more realistic about what they were trying to find.

"Review of recent literature," Simpson writes, "shows that most [researchers] have *assumed* . . . that once life arose anywhere its subsequent course would be much as it has been on earth. . . ."

But "the fossil record shows very clearly that there is no central line leading . . . from a protozoan to man. Instead there has been continual and extremely intricate branching, and whatever course we follow through the branches, there are repeated changes both in the rate and in the direction of evolution. . . . Moreover, the vast majority of earlier forms of life have become extinct without issue."

Besides that, says Simpson, no species ever evolves twice. "That is so not only because of the action of selection through long chains of nonrepetitive circumstances. . . . It is also true because there is a more or less random element in evolution involved in mutation and recombination. . . . Repetition is virtually impossible for nonrandom actions of selection on what is there in populations. It becomes still less probable when one considers that duplication of what are, in a manner of speaking, accidents is also required."

Ergo: "The assumption that, once life gets started anywhere, humanoids will eventually and inevitably appear is plainly false."—*H. P.*

A colorful quiz

Pastel pink for little girls and powder blue for little boys—those are the colors that parents choose. If it were up to the children, their preference might be much different.

by John and Molly Daugherty

1. At what age is the lens of your eye most sensitive to the transmission of blue and violet colors?
   a. 40 years
   b. 21 years
   c. 6 years

2. What color walls are best for a person with high blood pressure?
   a. Pink
   b. Blue
   c. Yellow

3. What color of toys or clothes delights a child under six the most?
   a. Red
   b. Green
   c. Blue

4. Which parts of your eye give you color perception?
   a. Cones of the retina
   b. Rods of the retina
   c. Blind spot on the retina

5. Approximately how many colors are considered different commercially?
   a. 5,000,000
   b. 500,000
   c. 50,000

6. If a surgeon is operating, what color should the walls of the operating room be in case he looks up?
   a. White
   b. Green
   c. Yellow

7. In an atomic blast, you would be least protected from burns if you were wearing a
   a. Grey flannel suit
   b. White suit
   c. Black suit

8. What causes the rainbow in a soap bubble?
   a. Interference
   b. Diffraction
   c. Refraction

9. The color most visible to you is
   a. Red
   b. Orange
   c. Yellow

10. Which light would you use to pep up a party?
    a. Rose incandescent
    b. Blue fluorescent
    c. Yellow incandescent

(Turn the page for the answers)

Answers:

1 - c A young child with normal vision has very clear eye lenses. As one ages, the lens becomes slightly pigmented. This process reduces the absorption of short wave lengths of light for transmission to the retina. The cornea and fluids in the eye also have an effect, but that of the lens pigment is greater. The nerve area near the central fovea of the retina is covered with some pigment too, which prevents over-stimulation of the retina by light rays, especially ultra-violet and violet.

2 - b Blue is the most cooling and relaxing color. A European hospital uses blue in the surroundings of patients with high blood pressure and red in those of patients with low blood pressure. It uses amber yellow for those with mental trouble.

The warm colors (red, orange, etc.) stimulate you. The cool colors (blue, green, etc.) soothe you.

3 - a Children and primitive people respond strongly to pure colors. Of these, children like red best and blue least. A child under six chooses red always unless he has been conditioned against it by an unhappy association. Yet parents dress their children in pinks and blues when the truth is the kid wants red!

4 - a The cones are largely concerned with day vision. They are most sensitive in the foveal pit, where about 50,000 are packed. They give you high visual acuity and color vision. Rods in the retina (some cones, too) are effective in night vision. In dim light, color perception is not reliable. There is some evidence that the cones in the central fovea are not sensitive to the blue end of the spectrum, so rods may play a part in color vision at this end.

5 - b Business and industry recognize about 500,000 colors. Actually the normal eye under the best viewing conditions can recognize surface colors estimated in the millions. For simplicity, the ISCC-NBC (Inter-Society Color Council and National Bureau of Standards) method for giving precise meaning to the names of colors lists 267.

6 - b The walls should be green. When you stare at red, you see green, its complementary color, on a white wall. This effect is the "after-image."

A surgeon looking at red blood would see a green after-image on a white wall if he glanced up. If the wall were green, however, the after-image of green would be negligible, and his vision would recover quickly when looking back at red blood.

7 - c The darker your clothes, the worse your burns would be. Dark clothes absorb light. Light ones reflect it. Light absorbed is converted into heat. Hiroshima victims who were wearing prints had the pattern of the print etched into their flesh in deep burns where the print pattern was dark, but only in surface burns where the print tones were light.

8 - a White light is composed of various colors each having a different wave length or a short range of wave lengths. When light falls on a soap bubble, some is reflected from the outer surface, and some is reflected from the inner surface. Depending upon the thickness of the soap film at

the moment, the two reflected components for a particular wave length may come to your eye opposite in phase (out of step) and cancel each other. What you see is the rest of the white light—a display of colors. Because the soap film constantly changes in thickness, various colors appear as various wave lengths are interfered with.

9 - c Yellow has the greatest visibility, according to the British Color Council. Research proves many people dislike yellow, however: 40 percent have an aversion to it, but less than 10 percent, to red, green, or blue. Most men and women like blue best.

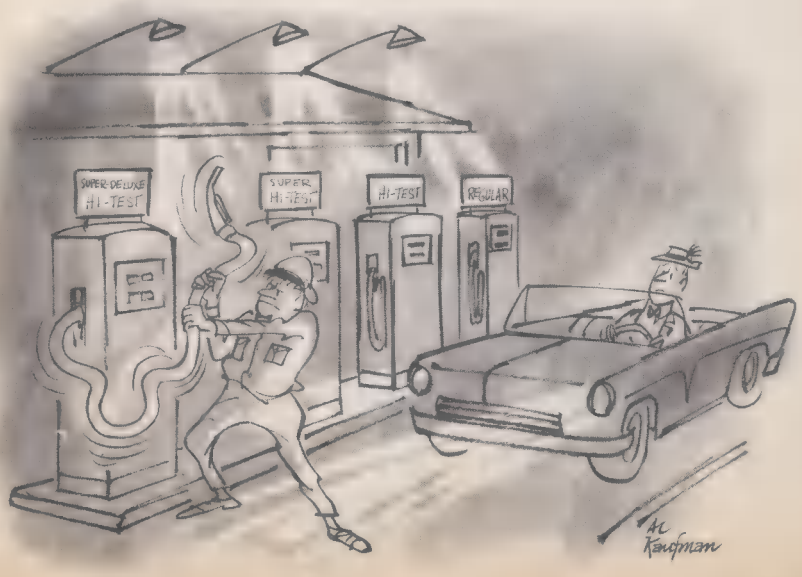
Because yellow is so good for visibility, school buses and taxi cabs are usually yellow. Children's raincoats are often bright yellow—an excellent choice. Industry uses yellow on machinery projections and low beams, etc. Highways have double yellow lines when you mustn't pass, and yellow tells you to wait at stop lights.

10 - a According to color specialists, rose or magenta-red light bulbs work like a charm at any party. Every one sees every one else through "rose-colored glasses." Even the food looks better in a warm light.

At a canteen with different lights on opposite sides of the room, the side with warm lights always filled up. The other side didn't. Under cold light, the margerine looked green, but it became a rich butter under the mellow fluorescent!

Score yourself:

9 - 10 right—You're in the pink!
4 - 8 right—You'll do. Don't feel blue.
0 - 3 right—Don't see red just because you're green!



The Last Primitives

In the forbidding Mato Grosso of Brazil live the last of the world's truly primitive people. The pictures on these pages show their astonishing lives.

THE basin of the Upper Xingu lies between the equatorial forest and the Brazilian Plateau. Its natural boundaries have long preserved it from civilization.

The Indian tribes there, in spite of a great diversity of language, have a common cultural heritage and their peaceful life is sustained by joint annual celebrations.

Today the area can be reached by air. But the pressure of technical advances and the diseases of civilization have brought about such a decline among the people that they may soon disappear.

Left: Women grind manioc root, the primary item in the diet of the Indians.
Below: Their other source of food is fish, and the men are superb fishermen.

All photos World Health Organization

All Indians sleep in hammocks either in the communal hut, or outdoors. In the background is a rack used for drying fish which are to be saved for a major feast.

Fish are caught by two methods, either with bow and arrow or by poisoning shallow water and then netting the dead fish or wading in and picking them up by hand.

During festival time, brightly painted musicians playing long deep-toned flutes visit each house in the village to drive out the evil spirits that may be hiding there.

LIVING in a hostile landscape, in a climate marked by the alternation of wet and dry seasons, the Indians have adapted themselves to their surroundings and make effective use of what nature offers.

Manioc root, which is poisonous unless properly prepared, is dried into cakes and spread with fish paste, for the main meal of the day. Diets are supplemented by fruits and nuts.

A VILLAGE usually consists of several large communal huts, arranged in a circle around an open space where games and dances are held. Each hut is inhabited by members of related families, who are represented on a sort of community council by one of the older men.

Hammocks are hung between the center post of the hut and the wall in a precise order. Those of husband and wife hang one above the other. The wife sleeps nearest the ground and has to keep the fire burning during the night and look after the child that shares her hammock.

When they are not out in the forest or on the river, the men usually sit together in the village circle and discuss fishing experiences and coming feasts or reminisce about notable feasts of the past.

Men usually have only one wife and there are not many children.

In the hard environment, children must learn the skills of adult life early in order to help the tribe survive.

Large family groups live in palm leaf-covered communal huts.

Aside from preparing the food, tending the fire and caring for the children, the women must also perform the tedious task of spinning cotton on simple instruments.

Men, too, aid in preparing the cotton, and it is only fair. Since the tribespeople wear no clothes, the cotton is used for hammocks and ornamental belts for the men.

Inventor of the month

Scientist-sportsman Dominique Gignoux has his laboratory in Washington, D.C., heads his own company.

Through space with a liquid spray

A FRENCH-BORN scientist has invented an apparatus to propel a space vehicle with a jet of tiny, electrically charged liquid particles. The particles, which are about a millionth of an inch in diameter, are expected to have a velocity of 12 miles or more per second.

Science Digest Inventor of the Month is Dominique M. P. Gignoux, president of Cosmic, Inc. His laboratory, which has a staff of 20, is in a large converted stable in the Georgetown section of Washington, D.C.

Patent No. 3,120,736, which was recently granted Mr. Gignoux, is the first, so far as he knows, for space propulsion with liquid particles. His system uses both centrifugal force and electricity to produce the powerful charged spray.

The propellent liquid forms a thin film on the inside edge of a spinning, cup-shaped nozzle. Electric forces from a series of electrodes pull the particles off the nozzle's lip. The technicians have found that they could simulate the path of the particles by letting BB shot roll on a thin, flat sheet of rubber distorted by pressure from beneath.

Under a development contract with the National Aeronautics and Space Administration, Mr. Gignoux is now trying to find the best liquid propellent. He has been testing oils and low-melting metal alloys.

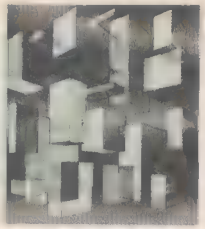
The Gignoux engine is intended to move a satellite or manned vehicle—once it has been rocketed into orbit—under airless and weightless conditions on long interplanetary journeys. A nuclear reactor in the craft would be relied on to supply the 500,000 volts needed to charge and accelerate the particles.

Ion engines, expelling charged molecules of cesium or mercury, have also been designed for electric propulsion. Mr. Gignoux's studies have convinced him that the liquid method is much more efficient and requires less power.

Mr. Gignoux organized Cosmic, Inc., three years ago. It is principally engaged in research and development for the government on space problems and the detection of missiles in the upper atmosphere.

The inventor, who is 35 years old, has an M.A. from the University of Paris in physics and mathematics and an M.A. from Harvard in economics. His father, the late Professor Maurice Gignoux, was a geologist and member of the French Academy of Sciences. The son was an enthusiastic mountain climber in the area of his native Grenoble. In this country his favorite sport is skiing.

—*Stacy V. Jones*



INVENTIONS
PATENTS
PROCESSES

Quartz infrared lamps add to the comfort of sports fans at Hawthorne Race Course.

Ain't life grandstand?

SPORTS fans at five Northern race tracks and a Texas baseball stadium will be more comfortable this year thanks to two innovations.

The race tracks have installed quartz infrared heat lamps that will be turned on before fans arrive to preheat the seats and grandstand floor areas. In Houston, Texas, a special dome of acoustical absorption materials and skylights will cover both players and spectators, shutting out wind and rain, and silencing the sound of an immense air conditioning system.

The dome of the new Harris County Stadium, future home of the Houston Colts baseball team, will rise 202 feet high, spanning the field and the 65,000-capacity seating area. Not even a hurricane will stop a game in Houston when the stadium is completed this year. It is designed to withstand hurricane wind gusts of 165 mph.

The sounds of play will reach the grandstands unobstructed, and 26 batteries of special silencers made by Industrial Acoustics Co., Inc., New York, N.Y., will muffle any sounds made by the air conditioning system so fans can watch their favorite sport without disturbance.

On the infrared circuit, Hawthorne race track, in Cicero, Ill., uses about 1,300 General Electric quartz heat lamps. The lamps are also being used at Maywood Race track, Chicago; Hazel Park track, Detroit; Lincoln Downs, Lincoln, R.I.; and the Rideau Carleton Raceway, Ottawa, Can.

In addition to preheating the seats and floor, some of the infrared radiation is reflected upwards from the warmed surfaces of the concrete aisles and floor and backs of seats, providing additional personal comfort.

One advantage of the quartz in-

frared lamps is that their radiant energy heats people and objects, not the surrounding air. They also provide lighting as well as heating.

Glove compartment tire

An automobile tire that can be folded up and stored in a glove compartment has been patented by The B. F. Goodrich Company, Akron, Ohio.

The "crutch," as the tire has been nicknamed by Goodrich, was developed as a space-saving substitute for the conventional spare. It is intended for emergency use only. It resembles an inner tube more than a standard tire, and is designed to run about 500 miles at moderate speeds. It has a thin, smooth tread and a highly flexible carcass with a minimum number of fabric plies.

The patent, issued to Goodrich engineers Frank Herzegh and James Pond, covers a design that can be collapsed on the spare wheel to save space, or removed from the wheel and folded for storage.

Goodrich has no immediate plans to market the tire, although it was developed in response to automobile manufacturers' requests for a compact spare and may come as original equipment on future automobiles.

Underwater elevator

Off the Mediterranean coast of France, a "buoy laboratory" is just a fancy name for a seagoing elevator that goes down into the sea so that scientists can make underwater observations.

This French buoy laboratory is equipped with a special type of elevator that carries scientists underwater for observations.

The one-man elevator is contained in a vertically-floating tube nearly 200 feet long, designed by the Oceanographic Museum of Monaco in cooperation with the French Office of Submarine Research. The elevator was installed by the French affiliate of Otis Elevator Co., and it runs 93 feet from a superstructure above the water line to four underwater observation chambers.

A scientist descending in the elevator can stop the car at any one of 20 small portholes spaced in line with a window in the elevator.

The roof of the laboratory serves as a helicopter landing platform with an area of 645 square feet, and the superstructure houses a four-man laboratory crew as well as power generating and elevator operating machinery.

Reservoirs near the bottom of the tube hold fuel and fresh water. Nylon and polypropylene cables anchor the buoy to the sea bed, in some places 8,000 feet down.

Quick hyperbolic navigation

A hyperbolic navigation system light enough to be carried as a pack on a man's back and also capable of showing geographic position on a pictorial display, has been developed by the Instrument Division of Lear Siegler, Inc., Grand Rapids, Mich.

Hyperbolic navigation is a system of determining exact location by utilizing radio waves from Government stations. Ordinarily, a person trying to determine his exact location would compute the amount of delay in receiving the signals from three pairs of radio stations at known locations. This information would be charted on a graph in the form of intersecting hyperbolas. It would take three pairs of coordinates before the three hyperbolas would all intersect at the same point and give only one possible answer to pinpoint the exact location.

The LORTAN (long-range and tactical navigation) system, accepts transmitted radio signals and automatically converts them to conventional grid coordinates, automatically charting the geographical location on a map.

In the past, a big difficulty in long-range and tactical navigation has been the length of time it took for manual conversion of hyperbolic information into conventional geographic coordinates. The advantage of the LORTAN system is that it makes possible the use of a single receiver/converter for any hyperbolic navigation system.

Described by its designers as ideal for tying all elements together in a combat situation, the 21-pound receiver/converter can be adapted to a man-pack for ground-based personnel and for ground support vehicles as well as airborne weapon systems.

Any treasure to bury?

The asbestos Hide-Away pouch is designed to safeguard valuable papers such as deeds, stocks, and cash in case of fire. Its new type of asbestos cloth is coated with a layer of aluminum which reflects 95 percent of radiant heat, to temperatures of 2000°. The pouch is also vermin-proof and rot proof; it can even be buried in the ground without decaying.

The pouch is silver-toned with golden edges, and its fold-over flap closes securely with snap closures. It comes in two sizes: 6 by 9 inches,

Asbestos Hide-Away Pouch provides safe-keeping for valuable documents.

and 9 by 12 inches. Available from Practical Products Co., Dept. 131, P. O. Box 371, Ardmore, Penna.

Automatic catcher

Bang-A-Ball, a device that makes it possible to improve baseball, golf or tennis skills by yourself, indoors or outdoors, is being offered by Ted Maxwell Co., 4760 Livernois, Detroit 10, Mich. The user pitches or hits a ball at a target, and the ball is returned down a ramp automatically, whether it hits the target or not.

Model A-1 comes with a net, and is 60 feet long. Model B-1 is netless. It can be installed in a garage, playroom or back yard.

Chair converts for ironing

The Castro Ready Lady Chair is an easy-chair with an attached folding ironing-board, a steam iron, a hair dryer and cord and plug connection for electrical outlets. A piece of fabric attached to the back of the chair by self-adhering Velcron edges is merely removed for easy access to the storage compartment containing the ironing board.

The chair comes in a wide choice of designer fabrics and colors. For further information write the Castro Convertible Contract Furniture Division, 519 8th Ave., New York 1, N.Y.

Baby's vanity case

The Krib Kaddie holds baby's accessories and will hang almost anywhere that is convenient, such as the edge of the crib or playpen. It can be used to hold such items as powder, baby oil, and diapers.

Made of break-resistant polystyrene, the Kaddie comes in white, with yellow pin cushion; blue, with pink pin cushion; and pink, with blue pin cushion. It is manufactured by Fox Crafts Inc., Fredericksburg, Va.

Little lamp

Sub-miniature electronic lamps with magnetic bases got a workout on the 'round-the-world-cruise of the University of the Seven Seas (*Science Digest*, Feb. '64), a pleasure ship converted into a school.

The lamp has 80-foot-candle intensity at six inches, up to 2,000 foot candles for use with microscopes. According to the manufacturers, the Tensor Corp., it is the world's smallest reading lamp.

The moon, with ⅙ the earth's surface gravity, would be a delight for high jumpers and weight watchers. But the giant planet Jupiter would be a nightmare. And on a body the size of our sun, a 180-pounder would weigh an incredible 2½ tons.

Gravitation—science's big riddle

We all know what gravity is—or do we? Here is a simple explanation of what science has discovered about it—and has yet to find out.

by H. Hellman

WE ALL feel it. Throughout our lives, we resist it, succumb to it, overcome it and use it. It is, perhaps, the principal force of the universe.

Yet gravitation today still eludes our understanding. It is science's big riddle.

We have been trying to unravel the mystery since modern science began in the 17th century. That was the age of the first scientific societies and journals; it saw the invention of both the telescope and microscope; it was the first time that careful observation was combined with mathematical reasoning; and it was an age that saw the first true understanding of forces and motions.

Yet the tides remained a deeply puzzling phenomenon. The astronomer Kepler had suggested that the tides were caused somehow by the

moon. But Kepler was also an astrologer, and believed in many other celestial influences. That's why the great Galileo laughed at him for having "given his ear and assent to the moon's predominancy over the water, and to occult properties and such like trifles." It remained for Newton to show, almost a century later, that the tides are indeed caused by the gravitational pull of the moon, and to some extent, the sun.

Aristotle was wrong

Now let's move back in time for a moment. In the fourth century B.C., Aristotle "proved" that the rate of fall of a body is proportional to its weight. That is, a ten-pound weight falls ten times faster than a one pound weight. Unbelievable? Perhaps; but consider this: Aristotle's idea was accepted as gospel for 2,000 years—until it was finally demonstrated to the satisfaction of the "scientific community" that, if we exclude air resistance, all bodies fall at the same rate. Who demonstrated this? Galileo.

Both of these phenomena derive from gravity. How then could Galileo have been so right and so wrong at the same time? Well, his experiments with falling bodies could be called "down to earth." Even though he was going counter to 2,000 years of doctrine, all he needed, really, was open eyes and an open mind (obviously not as easy as I make it sound).

It is instructive to repeat Galileo's experiment, in principle at least. Drop a coin and a piece of paper from the same height and at the same time. The coin will obviously fall much faster than the paper. The obvious conclusion is not always the right one.

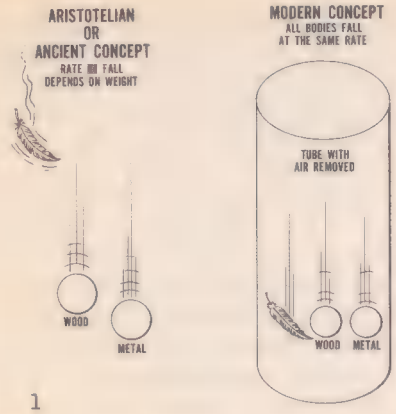
Now crumple the paper and roll it into a tight little ball; it will fall almost as fast as the coin. And if you had a long glass cylinder from which all air had been removed, you would see that a coin, a flat piece of paper, and even a feather would all fall inside the cylinder with exactly the same acceleration; that is, with the same, steadily increasing speed.

But the tides are another matter, for they represent a far more subtle interaction of cause and effect, if only because of the distances involved. And to confuse matters even further, the prevailing view for centuries was that the celestial bodies were divine and not ruled by the same laws as those here on earth.

Galileo's arguments

Galileo may have laughed at the wrong time, but he made vast contributions to the advancement of science nevertheless. For in addition to experimenting with falling weights, he provided convincing arguments and evidence to a highly skeptical world that the earth revolved around the sun, and not vice versa. To Kepler, incidentally, we owe the first mathematical description of the motion of the planets.

Motion or force can be said to be



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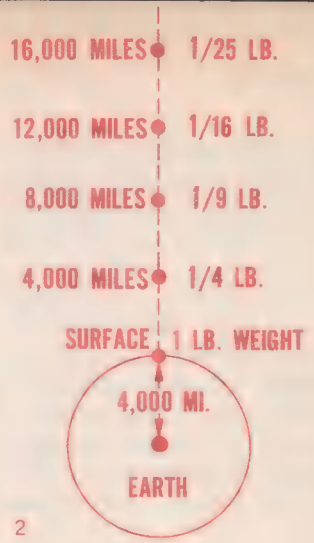

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1. The ancients believed that rate of fall was proportional to weight, but we now know that apparent differences in rate of fall are due to air resistance.
2. The weight of an object decreases as its distance from the earth's center increases.
3. If space is curved, as modern mathematical theories indicate it is, a ray of light should travel a curved path. Thus if we had a powerful enough telescope, we could turn in the direction opposite to the moon and see the opposite side of the moon. But it is not likely that we will ever be able to do this because the curvature of space is tiny and there is a limit to the power of optical telescopes.

understood when laws, or preferably a single law, can be formulated that can explain the experimental observations and make it possible to predict the outcome of new experiments. Thus we can say that by the middle of the 17th century, something was known about falling bodies, forces, laws of motion, and motion of the planets. But the field of knowledge was still a mess. Was it really possible that all these actions were different and had to be understood independently? Where to from here?

The next step was almost half a century in coming, but it was worth waiting for. In 1687, Newton put

forth one assumption—his Law of Universal Gravitation—which successfully explained and summarized such seemingly diverse matters as the falling of an object, the tides, and the motion of the planets. This law, at once wonderfully simple and incredibly complex, says that every particle of matter in the universe attracts every other particle with a force that depends only on the masses of the particles and the distances between them. Hence the moon and sun pull on the earth's waters to create the tides, the sun holds the planets in orbit, and so on. In this way, the whole visible universe, both heaven and earth, was brought together for the first time.

You and the earth

Let's look more closely at Newton's law. First, as we stated, the strength of the gravitational pull depends on the mass of the body doing the pulling. For example, you exert a pull on the earth, but its effect is infinitesimal. On the other hand, the earth's pull on you is what keeps you from being thrown out into space by the rotation of the earth.

The moon, being much smaller than earth, has a surface gravity only $\frac{1}{6}$ as large. A 180-pounder on earth would weigh only 30 pounds there. A batter who could hit a ball 400 feet here could smack it half a mile on the moon.

On the other hand, on Jupiter, which is much larger than earth, the 180-pounder would barely be able to drag his 475 pounds around. And on the sun he would collapse, crushed under his own weight of $2\frac{1}{2}$ tons. This is because the sun is vastly larger than the earth, almost inconceivably so.

Interestingly, the gravitational pull of any body acts as if it springs from the center of that body. And as the distance between the centers of the bodies increases, the gravitational attraction between them decreases by a specific amount—the mathematician says "inversely as the square."

Now recall for a moment Galileo's experiment with the falling weights. The significance of the result—that all bodies fall with the same acceleration—is easily lost because of the simplicity of the demonstration. Thus until very recently this result was accepted at face value, an interesting coincidence.

But modern physics, which can be said to date roughly from the beginning of this century, looks at it as a new and essential clue leading to a deeper understanding of nature; for Einstein reasoned that if all substances, of whatever kind or weight, experience the same gravitational acceleration, the acceleration could be regarded as characteristic of the physical space in which the matter is falling rather than of the matter itself. He proposed therefore, in his General Theory of Relativity (1916), that the gravitational acceleration be interpreted as a purely geometrical effect and that the trajectories of falling bodies be regarded as geometrical curves im-

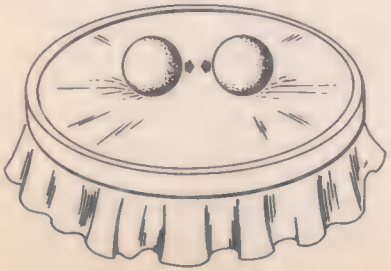
posed on them by the "curvature of space."

Do we really mean that space is curved? For example, if we had a telescope in space and pointed it at the moon, could we then turn the telescope in the opposite direction and see the back of the moon? The answer is yes. But as always, it is not that simple. First of all, the curvature of space is very small; thus the light would have to travel a mighty long distance before it came back to where it began. The second problem is that our telescopes are not powerful enough, and are not likely to become powerful enough. There is a theoretical as well as practical limit on the size of optical telescopes.

However, other means of measuring the curvature of space are possible. For example, if the concentration of nebulae (dust clouds in space) is found to change with distance, we may be able to obtain a measure of the curvature of space.

If it is still not clear to you that the connection is between the curvature of space and gravitation, perhaps a three-dimensional analogy will help. Suppose we placed two metal spheres on a smooth surface. We know that there is a gravitational attraction between them, yet they don't move toward each other. The reason is that the attraction is so slight that it can't overcome other forces, such as friction and inertia, which tend to keep the spheres in place.

Gravitation may not be a pull but merely the result of the curvature of space. An analogy for this is what happens when two balls are placed on a tightly stretched cloth. They seem to be drawn together by some mysterious force.



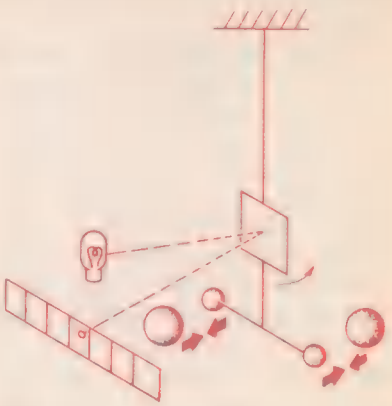
Structure of space

Suppose we now put the spheres on a cloth which is stretched tightly over a ring. They will move toward each other, apparently drawn together by some mysterious force. We know of course that this force does not exist, that the spheres are merely rolling toward the center of the cloth which is giving slightly and creating a "curved" space.

In a roughly similar way, it is thought that gravitation does not exist in the way we usually think of it, i.e., as a "pull," but is merely a result of the curvature of space caused by the presence of massive bodies. Thus, as we said before, the emphasis has come to be placed on the geometry or structure of our space rather than on the matter within it.

The geometry with which we are all familiar, that is, Euclidean geometry, is not the only one in existence. Mathematicians have been creating other geometries, including some of more than three dimensions.

The Cavendish balance measures the gravitational force of attraction between masses.



How to weigh the earth

We know that the gravitational attraction between bodies depends solely on their respective masses and the distance between them. Now suppose we know the mass of a particular body very accurately, can we consider the earth as just another mass, and, by means of Newton's equation, "weigh" it? Yes we can; and here's how it is done.

Newton's equation is:

$$F = \frac{Gm_1 m_2}{r^2}$$

where F is the gravitational force between two bodies of mass m_1 and m_2 a distance r apart. G is called the universal gravitational constant. Without it we couldn't put numbers in the equation.

Einstein, in developing his general relativity, adopted a four-dimensional general geometry developed by the German mathematician Riemann in 1854. Instead of a fourth space dimension, however, Einstein made time his fourth dimension. There is nothing strange about this concept; it merely reflects the fact that every event takes place in both space and time. Thus we can have movement in time as well as space.

As we know, however, we can't even visualize a four-dimensional curved space, let alone its fourth time coordinate. Hence, according to this theory, we are living in a space whose structure we can never grasp or understand. We can comprehend only the three-dimensional cross section of the four dimensional curved space-time of our universe.

We can now see the importance of the mathematical approach. Here a full but non-intuitive understanding can be gained. That is, although

From experiments with falling bodies, we know the force F with which the earth, which we'll call m_1, attracts our small mass m_2. We said we knew m_2 very accurately, and we also know r, which is just the distance of m_2 from earth's center. So far we don't know the value of G. But this was found as long ago as 1798 by means of an ingenious device called the Cavendish balance after its builder. The balance consists of two small spheres, usually of gold or platinum, mounted at opposite ends of a light horizontal rod which is supported at its center by a fine vertical wire such as a quartz thread. A small mirror fastened to the fiber reflects a beam of light onto the scale. To use the balance, two large spheres, usually of lead, are brought up to the positions shown. The forces of gravitation attraction between the large and small spheres causes the fiber to twist; the mirror swings through a small angle, thereby moving the light beam along the scale, providing a value for G. The more the swing, the greater the gravitational attraction.

Using the resulting figure in Newton's equation, we can now calculate the mass of the earth, which turns out to be 6.6×10^{21} tons, that is, 6.6 followed by 21 zeros. Now this is such a gigantic figure that it is almost meaningless. But look what science can do with it. By a simple solid geometry formula (i.e., $V = \frac{4}{3}\pi r^3$) we can determine the total volume of the earth, which turns out to be about 26 billion cubic miles, another incomprehensible figure. But if we divide the weight of the earth by its volume, we obtain a density, or weight per unit volume, for earth. This figure is 343.4 pounds/cubic feet, or more than 5 times the density of water. Since this figure is considerably higher than the average density of the material near the earth's surface, we must conclude that the interior of the earth is of much higher density. This matches concepts generated in other ways and shows how scientists are sometimes able to check their theories.

we cannot picture the form of the "new" universe, we can describe it mathematically. But, you may ask, how do we know it is "true" if we can't match it up with our own experience? Any theory, if it is to be of any use whatever, must either explain some hitherto unexplainable phenomenon, or predict some phenomenon which, preferably, can be tested in a quantitative way.

In the case of general relativity, both kinds of proof have been obtained. The theory has been able to explain a motion of Mercury's orbit that just couldn't be reconciled with Newtonian theory, and it has also been able to predict two new phenomena. One of these is the reddening of light originating in a small, dense star. The other is the deflection or bending of light rays that pass close to the sun. This was a great surprise since, as you know, it had always been thought that light travels only in straight lines.

These three effects show that space and time near massive bodies differ from space and time away from such bodies. Hence, whether you like it or not, you are living in a four-dimensional, curved, space-time continuum. But the curvature is so slight that it isn't likely to upset your day's routine. And under "normal" circumstances, i.e., those which you encounter in your daily life, Newton's theory is perfectly adequate. It is only in areas of strong gravitational interaction that these other effects come into play. Mercury is a good example; being the closest of all the planets to the sun, it is the only one where the relativistic effects are large enough to show up. But even here, the discrepancy amounts to a grand total of 43 seconds of arc (about 1/90th of a degree) per century.

Small things are vital

A small effect indeed. Why then did we ever worry about it? Because it showed our understanding of nature was imperfect.

Newton's work was assailed by some of the foremost scientists of his day as "unphilosophical," because he offered no explanation of the ultimate cause of gravitational attraction. But Newton felt that it was not necessary to know the cause; he regarded that as a secondary and independent problem, as yet only in the stage suitable for speculation. It is a testimony to the wisdom of his scientific spirit of caution that in spite of many attempts, no satisfactory mechanical explanation of gravitation has yet been given.

One of the unknowns that still remains is the absence of polarity in gravitation. Whereas magnetic and electric forces have a polar character, (they exhibit attraction and repulsion), the exclusively attractive character of gravitation remains a mystery. It should also be mentioned that the experimental corroboration of Einstein's theory has been close—within experimental error—but not exact, indicating that there may still be factors of which we are not even aware.

Almost since Einstein propounded his General Theory, scientists have also been working on the creation of a Unified Field Theory, one that would tie together into one package both gravitational and electromagnetic field theories, which are similar in many ways. Einstein himself, believing in the fundamental unity of nature, spent the last years of his life in an unsuccessful attempt to do this. But the dream of such a theory is as tantalizing as ever.

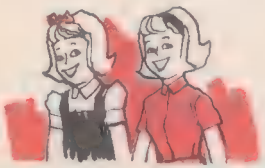
Perhaps in accomplishing this, some great mind will bring order to the puzzling array of fields, forces, and particles that still confront us, just as Newton brought order to what was known of the physical sciences in the seventeenth century. It is possible that a successful Unified Field Theory will also provide the clue that will finally clear up the puzzle of gravitation—which remains one of the most stubborn mysteries of our age.

How puberty affects personality

THE age at which a girl matures physically may strongly influence her personality in later life.

A study of 82 women between the age of 20 and 50, by Dr. William G. Shipman of Chicago, disclosed that women who developed at the early age of 10 and 11 tended as adults to be more conservative and uncritical in their thinking, more lax and inexact, more trusting of others, and more group dependent.

On the other hand, he discovered that women developing later than normal, at age 14 or older, were more dominant and aggressive, more critical thinking and ready to experiment, more suspecting and more self-controlled.



Dr. Shipman cautions that the "magnitude of the relationship," is still small. But that in at least a portion of the cases there may be "some principle of causation." It is widely accepted that early or late adolescence seems to be a very important factor in shaping personality in adolescence.

Physical maturity is influenced by heredity, climate and race. Typically it occurs at age 13 in girls. While the early developing boy easily becomes a self-assured leader with other boys his age, the early developing girl is at a decided disadvantage, according to Dr. Shipman.

"She becomes physically conspicuous among her classmates at a time when teenagers are most sensitive and easily disturbed at being different from their associates," he says. "Too much may be expected of her intellectually and emotionally because of her more mature appearance."

Dr. Shipman speculates whether an early maturing girl's retiring manner in adolescence attracts men who need to be clearly dominant and that marriage later makes these roles permanent.

As for the late maturing girl Dr. Shipman says, "As time goes on, she may become more aware of and embarrassed about her difference from other girls. She may react by either

trying to keep up with more mature girls socially or she may withdraw into solitary activities." It would seem natural for her to move away from social frustrations to intellectual, school matters, he adds. Late maturing girls are under somewhat less stress, but they still have increased personal problems.

"Apparently, early or late adolescence has an effect on increasing or reducing further intellectual growth," says Dr. Shipman. "It also seems to influence the degree of social concern developed in the individual."

Talk yourself into it

Can parents make a child talk himself into liking, say, brown bread?

University of Michigan psychologists have found that such manipulation will work with young children (under 10½ years of age) but it may generate some degree of counteraction among other children.

The psychologists designed an experiment with a group of retarded children. In one section of the experiment, the children said repeatedly, "I like the brown bread," and were rewarded for having said it. As a result, the younger children ate more brown bread. The older group however, ate less brown bread, and compensated for it by eating more white bread.

Then the experiment was structured a different way so that the children were simply told repeatedly, "You like brown bread," and rewarded for paying attention. The older group showed no increase in their brown bread consumption, whereas the younger children ate considerably more brown bread and showed a smaller increase in white bread consumption.

The psychologists were not interested in the nutritional advantages of brown bread. They were trying to test the theory that it is possible to manipulate a person's talk in a way that would cause him to change his actions or attitudes.

The study, made by Associate Prof. Harlan L. Lane, director of the behavior Analysis Laboratory of the University, had a secondary purpose: In today's society people learn early to spot and resist, even rebel against, any obvious attempt to change their behavior. Such reaction (or counter-control as behavioral scientists call it) would, in this case, take the form of a decrease in brown bread consumption and a more than compensatory increase in white bread consumption.

Retarded but educable children were used in the study because they might be expected to show less sophistication than normal children in recognizing manipulation as such. There was no persuasion or communication concerning the merits of

brown bread in the study, however.

Lane noted that some of his other studies suggest that these findings are not limited to retarded children.

Who can resist brainwashing?

Finding out what happens to a man when he is deprived of sensory stimulation, is one of the most active branches of psychological testing today. At the Washington State Health Research Institute near Steilacoom, Wash., 70 soldiers recently spent four hours each lying on their backs in bed, doing nothing. The only noise they heard was a constant low hiss piped through earphones, and their eyes were masked behind goggles which prevented them from seeing any recognizable forms.

The volunteer soldiers were not told how long they would have to spend in their isolated environment. When the four hours were up, the subjects guessed that they had been in isolation anywhere from 20 minutes to 12 hours.

The Army is interested in the project because it might shed light on the personality types that can resist the long confinement that usually is part of the brainwashing technique. Besides that, medical authorities want to know more about treating their mentally ill patients.

Subjects who in previous psychological tests were classed as introverts took the sensory deprivation much better than persons classed as extroverts. However, introverts, it was found, are unable to stand much pain.

Certain types of extroverts become uncomfortable and even threatened by sensory deprivation. The bed tests showed that they are starved for stimuli and open to suggestion—and possibly to brainwashing.

Of interest to psychotherapists was this finding:

A mental patient who internalizes his symptoms acts against himself, while an externalizer tends to strike out against his surroundings. Dr. John Marks, director of the institute, says that the internalized patient may respond to encouragement, sympathy and social approval, while the externalizer will respond more favorably to tangible rewards.

Say it with sickness

In at least half the cases a physician treats, the patient is using his illness to express an emotion that he is unable to express any other way. That is what University of California Psychiatrist Edward J. Stainbrook told a group of family doctors at a conference sponsored by the National Institute of Mental Health.

Many patients, Dr. Stainbrook told the conference, are trying to say, "Nobody cares about me, so I have to take care of myself. I'd like

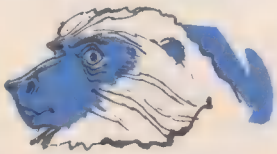
someone to care for me in the same way I care about myself." A doctor who merely treats such a patient's physical complaints is wasting his time, according to Dr. Stainbrook; the problem is in the patient's emotions.

Patients who simply want to be cared for feel that such an emotion is socially unacceptable, so they invent symptoms. But Dr. Stainbrook believes that feelings of dependency occur naturally at times of crisis in life.

What can a doctor do with such a patient? Says Dr. Stainbrook: He can listen sympathetically. Only a small number of such cases are serious enough, Dr. Stainbrook concluded, to require special help.

The neurotic baboon

Baboons are social primates, with intense family loyalty and savage tempers. In short, they are very much like human beings.



But recently scientists have been surprised to find just how much like us they really are. The *Journal of the American Medical Assn.* reports that baboons have proved to be excellent laboratory animals because they often react to disease in the same way man does.

Baboons may even become neurotic and, as a result, develop a heart or circulatory condition. The JAMA reports, "The most usual somatic manifestations of neurosis in baboons are hypertension and coronary insufficiency," often leading to cerebral hemorrhage and myocardial infraction, as in man.

Neurosis appears in baboons if their daily routine is changed too often. After about two months, they show such disturbances as disruption of conditioned reflex activity, and general behavior disorder; they pace nervously about the cage and tend to sway their heads pendulum-like; they show an antagonism to surroundings and even have what appear to be hallucinations.

The not-so-carefree poor

It is not the harried executive or tired white-collar worker who becomes psychotic or insane. The poor suffer from more serious forms of mental illness than do the middle- and upper-class people who are more likely to be neurotic.

These are some of the conclusions drawn by Thomas S. Langer in a new book, *Life Stress and Mental Health.* The author disagrees with the old theory that psychotics, because of their poor adjustment, naturally drift down into the lower classes. He claims that instead the early training of the lower-class child is more likely to produce a psychotic personality.

American children in the upper classes are more likely to be "trained into" neurotic personalities, he says.

The author looks over one of the instruments he says will vastly extend our mental power.

How would you like to have a computer in your home that takes care of all those annoying little tasks like balancing your check book, reminding you of birthdays and anniversaries and the like, answering your phone while you are away, etc.? It's just one promise of

The information revolution

by Dr. George L. Haller
Vice president for Advanced Technology Services, General Electric Co.

For the first time in the history of the world—as far as we can tell—the whole of mankind is undergoing a revolution. Some parts of the world are ahead of others, but all are committed to it. There is no turning back.

This world revolution has three parts. They are: *the revolution in power, the revolution in materials,* and *the revolution in information.*

The power revolution has made available for man's use much more energy than he ever had before. It has vastly increased human mobility and the exchange of goods throughout the world. Man's ability to do physical work has also been vastly increased by engines and machines that convert the energy of fuels and harness it to do our bidding.

"The 'intellectronic' machines of the future will assist us in the construction of philosophies, the attempt to understand the universe and man's relation to it."

The second aspect of our world revolution, the revolution in materials, affects the substances we use in everyday life—the clothes we wear, the food we eat, the tools and things that are useful or enjoyable in one way or another.

Chemists are learning to construct molecules with just the right properties, instead of hunting among thousands of existing kinds of molecules to find one that suits. Another aspect of the materials revolution is the increase in food production by encouraging and controlling nature.

Now we come to the third aspect of our world revolution. To my mind it is the most important and exciting of the three: the information revolution.

Guide and accelerator

The revolution in the fields of power and material is matched by a revolution in information. The information revolution guides and accelerates the other two.

We have no handy measure of brain power, thinking power. Estimates of the brain's capacity have been made, based on estimates of the number of individual neurons and their interconnections. They vary a great deal, but the lowest guess says the brain can store and handle a trillion "bits" of information. This is many orders of magnitude greater than the best digital computers, but the computers are being improved and the brains are not! Moreover, the reliability and input-output speed of the brain leave much to be desired. A computer can "take in" information many times faster than the brain, and its advantage in printout speed is even greater in comparison.

The human brain is a marvelous computer just the same. Its storage capacity, or "memory" is very great, and its programming can be infinitely more complex than that of a computer. It has vastly greater "logical sophistication" than the computer's ability to add, subtract, compare, and follow specific directions.

A man can be reminded of something—that is, he can "read out" from his computer memory—in response to a variety of stimulations: a picture, a word, a tune, even a smell. In other words he has a variety of input-output devices, but they are rather unreliable. The extra circuitry that seems to be built into all living things cannot make up for this basic unreliability of memory. Physio-chemists tell us that those forgotten data are still there in the brain cells and pathways, but the access to them deteriorates.

Already computers are doing the

laborious, repetitive kinds of thinking. They make mathematical calculations that previously were too formidable or expensive to do by hand. It seems to me only a matter of time before machines will be able to do really sophisticated thinking. They can play a good game of checkers and a fair game of chess. At language translation, machines aren't very good, but they are learning.

Steps are now being made in machines that learn from experience, computers that change and revise their own programs as they go along. These self-optimizing systems, as they are called, come close to providing a motivation or goal to an inanimate system.

Incidentally, information theory and the men applying it have both benefited in a backhanded way from the deficiencies of computers and automatic systems in general. A machine is just too dumb to understand ambiguous or "fuzzy" instructions. Users quickly discovered that they had to think more clearly about their own operations in order to tell the machine precisely what they wanted it to do.

In countless areas of mental work, more of them than we can now imagine, computers and other intellectronic devices will extend our powers. The revolution will come from the teamwork of men and computers, utilizing the advantages and overcoming the disadvantages of each.

The intellectronic machines of the future will handle concepts and ideas as rapidly and surely as they now handle numbers. Manipulating logical concepts is different only in degree, not in kind, from translating languages. Then machines can assist us in the mental function we regard as the highest form of human endeavor: the construction of philosophies, the attempt to understand the universe and man's relation to it.

Man has a logical sophistication much greater than a machine and an exceedingly large memory capacity in a small space. His power needs are ridiculously low. On the disadvantage side, however, man gets tired and distracted. His access to his memory and his logical processes are unreliable. He needs motivation, and his input-output devices are slow and inexact. In the computer-man team play, however, the man will still call the signals.

Man the master

I do not share the fears of some that electronic machines may become so skillful at thinking that they may outwit their makers and be a menace. Man is still his own greatest enemy and will continue to be so. The role of machines in the information revolution will parallel their role in the power revolution. They will be aides and helpers, not masters.

Examples of the man-machine thinking team are all around us today.

One interesting application of computers and automatic data

"The time will come when the computer will take oral instructions. It will recognize your voice, or your wife's, but will be so ceded it will ignore anyone else."

processing to information retrieval is a system being developed by General Electric for the National Library of Medicine.

The library now has more than a million volumes and is the largest collection of medical literature in the world. General Electric is developing MEDLARS (Medical Literature and Retrieval System) to help the library publish its monthly *Index Medicus*. The Index compiles and carefully cross references about 11,000 items each month, appearing in medical journals throughout the world, and circulates this index to libraries, universities, hospitals and research centers.

MEDLARS will enable the library to double the size of the Index, to increase the precision of cross-referencing, and to assemble automatically special indexes on particular subjects. All the items will be stored in the MEDLARS "brain" for instant retrieval. Here is a combined communication and thinking use of a computer system.

From an automated library of medical research it is only a step to an automatic system for medical diagnosis, remembering and handling a much larger and more complex store of medical know-how than one doctor can manage. The results of the physician's tests, observations, the patient's history, and perhaps even the doctor's proposed treatment, would be fed into a convenient console in the office. Quickly, all this goes into a central network of medical information. It is processed instantaneously against the records and statistics stored there. Then back would come the machine's verdict on the diagnosis.

Memory prodder

I think the information revolution will lead to a home appliance that would beat them all for convenience, value and labor saving:

Think of all the methods you now employ to help you keep track of things in everyday life: shopping lists, check stubs, notes to yourself that you stick in your pocket and then lose, the spindle file where you spike the bills until pay day.

Why not have a little computer—about the size of a desk—to keep track of all these things for you? It would make up grocery lists, remind you of appointments, anniversaries; it could take care of your finances, your bank balance, paying household bills. (It might even write out the checks for you, and stop and sound a buzzer when the balance was getting down to the preset mark!) The computer could easily figure out your income tax, putting down all the deductions and giving you the best possible break. The home computer could be con-

nected to your telephone, so you could give it instructions or ask it questions when you're away from home.

Probably the first such home computers would have a typewriter keyboard as an input device. You would have to type out everything you put into it for storage; and it would type out the answers to your questions, the reminders, the lists and notes as you need them.

His master's voice

But typing is a chore compared with talking. The time will come when the typewritten input will be unnecessary, though the printed output will still be the handiest method. Then the computer will take oral instructions. It will recognize your voice, or your wife's, but will be so coded it will ignore and not listen to anyone else. No need for a key to lock up the machine. When you're away from home a thief cannot tell the computer to make out a big check to "cash." No mechanical lock in the world can match the complexity of a voice pattern lock, which will be as unique as a fingerprint but recognizable even when you have a sore throat!

Most of the concepts of my home computer have been tested and proved feasible in some military or industrial equipment that is operating today. It only remains to bring them together, and make the circuitry compact enough to be put into a single versatile appliance, and to make the appliance cheap enough so you and I can afford to buy one.

The information revolution, like the power revolution before it, will mean some disruption of employment, but in the long run it will create more jobs than it destroys. It will help create real wealth and improve living standards.

When power looms were first introduced in England, some of the weavers revolted and smashed the new looms. But the rebels were wrong on two counts: wrecking the new machines could not bring back the old hand weaving economy, and the new system created more jobs than there had been before.

The information revolution is the climactic, crucial battle in the wider development that is welding our world into one planet, with one diverse but unified citizenry. This movement transcends nations and ideologies. Technology has shifted its emphasis from muscles and things to thoughts and ideas. But the goal of technological change—in the field of information as in the field of power—is still the same. That goal is the betterment of mankind.

A SCOTTISH physician feels that it pays to "let yourself go" emotionally. "The evidence suggests that there is a significant association between personality and lung cancer," says Dr. David Kissen of Glasgow. His study of 300 patients shows that the lung cancer death rate of those with a poor outlet for emotions is over five times as great as for those with a good outlet.

Chimp Girl

WHEN you laugh at the antics of a chimpanzee in the zoo, do you ever have the uncomfortable feeling that the chimp is laughing at you too? Well he probably is, says a young woman scientist who has spent over three years in the East African jungle watching chimpanzees.

Twenty-nine-year-old Jean Goodall, an English scientist, thinks the chimps looked down on her as "an inferior creature—like a baboon."

Since 1960, Miss Goodall has been studying a community of primates in "Chimpland," the 30 square miles of forested valleys and treeless ridges of Tanganyika's Gombe Stream Game Reserve. She worked under grants from the National Geographic Society. Her almost superhuman patience has allowed her to record for science many aspects of chimp behavior that were unknown.

Left: When Jane Goodall came to Washington, D. C., to relate her experiences studying wild chimpanzees in East Africa, she made friends with Lulu, a baby chimp from the National Zoo.

Right: "David Graybeard," the only wild chimp that would allow Miss Goodall to touch him.

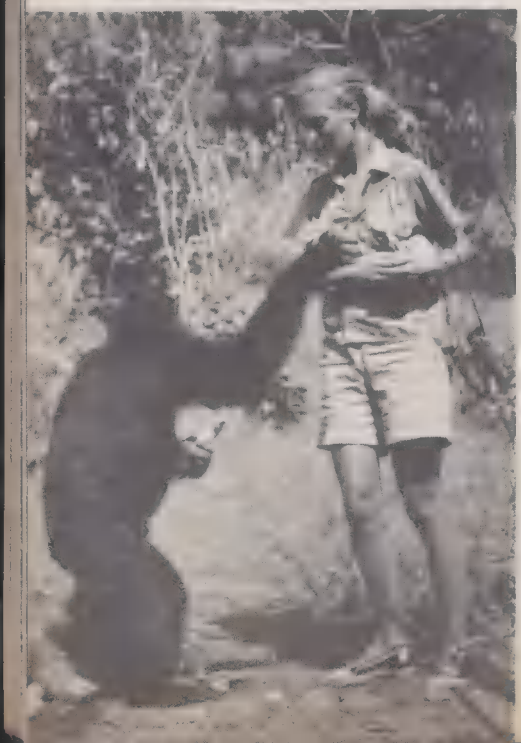
Photo by Baron Hugo van Lawick © Nat. Geog. Soc.

Photo by Jane Goodall © Nat. Geog. Soc.

Wild chimpanzees use stems as tools to fish termites out of a nest. The apes strip the leaves from twigs, and break off the ends if they become bent. Insects, considered tasty by the chimps, cling to the stems when they are withdrawn.

Photos Baron Hugo van Lawick © Nat. Geog. Soc.

A wild chimpanzee gets a handout of bananas from Jane Goodall. At first, chimps ran if she came near them.



Emulating Linus of the "Peanuts" comic strip, a chimp clutches a blanket he has just stolen from camp.

Miss Goodall observed several chimpanzees sucking water from a natural water bowl in a tree trunk. When the apes had gotten as much as possible this way, they picked up crumpled leaves. They dipped the leaves in the remaining water and sucked the liquid from them.

Incredibly, Miss Goodall also saw chimps use leaves as napkins to wipe sticky hands after eating. One female who slipped in the mud cleaned off the soil with a handful of leaves.

In recent months, she has gathered new evidence of chimpanzees' close family ties. In the wild, a mature female has a baby roughly every two or three years. She suckles the youngster and keeps it with her in the nest at night until it is about three years old.

Three-year-olds may leave their mothers for short periods. Six-year-olds often leave the family circle for two or three days at a time.

"One of the first times that a young male left his family for a day we were lucky enough to see the reunion," Miss Goodall recalled. "His small sister put her arms around his neck, and he went up to kiss his mother—a little peck on her face."

Miss Goodall's most significant find to date was the discovery that chimps fashion and use crude implements—the beginnings of tool use. The apes devise simple tools from twigs to aid in fishing out termites, a chimpanzee delicacy, from their earthen nests.

Miss Goodall also found that chimps influence one another's behavior by vocal calls. She has identified 20 distinct sounds that they make in different situations.

When excited, chimps sometimes throw objects. Miss Goodall has observed male chimps picking up and hurling large stones with an underhanded motion. Once, a male threw small stones overhand at a nearby baboon.

Miss Goodall was the first scientist to observe that chimpanzees eat small animals as well as their usual plant and insect diet.

Three or four chimps raided Miss Goodall's tent regularly. Their favorite loot was blankets, which they enjoyed sucking just as a small child sometimes does. At one time, her camp was down to its last two blankets.

They also stole eggs and young chickens. To top it all, one seized a handful of paper money and ran off chewing it. He didn't know this was the last of the "banana money" used to buy fruit for the apes.

Miss Goodall found that chimps show as much individuality as man himself, and she gives them names to fit their personalities.

"David Greybeard" has an exceptionally calm disposition and an air of natural dignity. He is the only chimp that allows Miss Goodall to touch him. He greets her with a friendly "Hoo!"

Miss Goodall has been interested in animals since childhood, when she tried her mother's patience after official bedtime by taking worms to bed to watch them crawl.

The Hugh Downs Column

IS THE UNIVERSE 'EVAPORATING'?

As a so-called "interested layman," I have dogged the scent and trail of cosmology for at least three decades and have gotten used to the idea that I have reached no conclusion about its major problems.

I have, you might say, arrived at the conclusion that I will never arrive at a conclusion.

But one thing that strikes me as a strange and clear thread running through advancing cosmology is what I can only call the "evaporation of the universe." There are five facets to this phenomenon:

(1) *Discovery of the distribution of matter.* In the dark ages and early Renaissance, the universe was solid and close. Heaven was squarely overhead and Hell yawned at the feet of the individual. Earth was loamy, rocks were cool and massive, the air was moist and fetid. Galileo's discoveries led to the realization of the enormous distances of the heavenly bodies. We have come to the appalling idea that star-spacing is so thin that if an average star were the size of a grain of sand it would be fifteen miles from its nearest neighbor! Thus, per unit volume, the universe is far less dense than had been supposed.

(2) *Matter is melting away through radiation.* The sun is losing its mass by giving off heat and light at the rate of several thousand tons per second. It is large enough to last many thousands of millions of years. Nevertheless, like an ice cube, it is surely diminishing in substance. This is true of all incandescent bodies in the universe.

(3) *Space between galaxies is increasing.* A force similar to gravity in nature but opposite in direction is causing a scattering of galaxies. This first gave rise to the expanding universe theory. Even the steady-state theory of the universe takes into account the apparent recession of galaxies from each other, compensating for those lost at the "edges" (determined by the limiting speed of light and the fact that galaxies are effectively lost to the universe when no light can return from them). Thus we see a third way in which the universe is evaporating.

(4) *Philosophic evaporation of the concept of solid matter.* The palpable particles that made up yesterday's atomic world are much less real than they were in the time of Niels Bohr. The proton and electron now have cousins by the dozens,

Television's Hugh Downs has long been kidded for his erudition on a variety of scientific subjects. In truth, he is a serious student in such fields as astronomy and aerodynamics. Here, the star of the "Today" show, who told us last month about the New York World's Fair, writes the first of a series of columns on science especially for Science Digest.

and none of the particles has the hard core it once had. Instead, particles now seem to be made up rather of their characteristic 'influences' in space. Some have dubious existence in the present, and the determination simultaneously of position and motion of particles is now believed to be futile and meaningless. Some even, which exceed the speed of light, can honestly be said to vanish and re-appear in such a way that the meaningful identity of a given particle is open to question. In short, what was believed to be a myriad tiny particles has been reduced to sets of 'influences' in continua of space and time. This has been further reduced to geometric components which can be couched in mathematical terms, which of course is pure thought. The palpable universe then simmers away to a gigantic thought, and some physicists believe we are created in God's image because we *think*.

(5) *The abandonment of goal: atrophy of the mind's demand for certainty—satisfaction through quest alone.* The last century has seen the gradual emergence of an attitude on the part of science that is characterized by giving up the idea of finding the Final Truth. Since this goal is the end of the road and since it seems likely that the road may have no end, the questing mind has adopted the quest as an end in itself. Here we have the evaporation of one of the important aspects of science: the metamorphosis of all theory into working hypotheses, of all objective truth into speculation.

In these five ways, not only the physical universe but also the very ground of Mind on which it rests is seen to evaporate. And this comes about, not from the gradual loss of some fundamental store of knowledge, not from the dwindling of some revealed stock of Truth, but through the steady amassing of facts. We learn more all the time about our physical universe, and the more we learn, the more the meaning of it is obscured. Indeed, many scientists now wonder what we mean by the meaning of the universe. Is a "meaning" any more necessary to the universe than an absolute frame of reference, or than flatness to the earth?

The seeming evaporation of the universe may be nothing more than the evaporation of outmoded concepts and methods of thinking.

WHAT HAPPENS WHEN YOU DIE

Science is beginning to look into the physiology of the body's death and has made some remarkable—and reassuring—discoveries.

by O. A. Battista

IN RECENT years, we have heard and read much about science's probing of the innermost secrets of life. We have learned much about the role of such mysterious entities of cell reproduction simplified by the symbols DNA and RNA. And now science is beginning to peer into the face of death.

The subject of death is probably disturbing to you. The reason is not that you deny its inevitability, but that you have a distorted fear of it. There is no human experience that man fears more and understands less, and this very dread prevents him from understanding it. Yet death is a major experience of life itself. In the United States alone,

about 12,000 persons die each day.

Death is the *one* inescapable fact of life—taxes notwithstanding. On the average, out of every 100 deaths in the U.S. today, 43 people die of heart disease, 17 people die of cancer, 12 people die of cerebral hemorrhage, 6 people die in accidents, 3 people die of flu and pneumonia, 3 people die of arteriosclerosis, 1 person dies a suicide.

The usual tests for clinical death are not infallible. Holding a mirror against the mouth and nostrils and watching for a tell-tale clouding is not trustworthy. Nor is bloodletting, resorted to on the theory that blood does not flow in dead men's veins and arteries.

Usually death is classified in two types of processes: agonal death concludes the last fight for life of the dying organism; clinical death is said to occur when the heart beat and breathing cease. For all medical purposes agonal and clinical death coincide with the end of circulation in the brain. Recently the injection of uranine (fluorescin sodium, a yellow dye) has been used as a trustworthy test for clinical death. If the blood still is being circulated, mucus membranes are rapidly stained yellow-green; there is no such response after death.

Immediately after death a series of physical and chemical changes take place and these continue in more or less orderly sequence until the remains disintegrate. The body cools, the blood gravitates to the skin, the muscles first relax, then stiffen and then relax again, there are chemical changes in the blood and tissues and finally—putrefaction.

Contrary to popular belief, the facial grimaces that often come with death are involuntary and not indicators of pain. Remember, faces are often contorted in sleep—although the sleeper is in no pain whatsoever.

But, in its efforts to understand death, science must begin by studying life. The same basic chemical reactions that provide vital energy to single-celled creatures also keep you alive. Slowing those reactions, slowing growth, is the secret weapon in science's attack on the problem of death.

A sliver of heart

Over 40 years ago a scientist trimmed a sliver of tissue from the beating heart of a chicken embryo and placed it in a nourishing blood-plasma fluid. The scientist was Dr. Alexis Carrel, Nobel Prize investigator of the Rockefeller Institute for Medical Research in New York.

The heart tissue grew. Each of its cells became larger and then split, giving rise to two young cells which in turn also split to form four new offspring. The process continued on and on in the great chain reaction of life.

If the "seed" tissue had not been trimmed down regularly and the cells had kept multiplying at their natural rate, the tissue would have grown to weigh almost four pounds after a month and more than

It is easy at the last. However great the previous suffering, there is an interval of perfect peace, often ecstasy, just before death.

65,000,000,000 pounds after three months. The chick-embryo fragment survived two world wars, and outlived Dr. Carrel himself before it was finally discarded in 1946.

That you can pinpoint the exact time of death by the degree of rigor mortis—the stiffening of muscles after death—is a fallacy, says Dr. Richard Ford, head of the department of legal medicine, Harvard Medical School.

Rigor mortis may never appear in a body, Dr. Ford said. If it does appear, it begins to disappear in 24 to 36 hours.

Dead how long?

The interval between death and the time the body is found is best determined by either the "association" method or the "rate method," he points out. The association method relates the death to concurrent events, such as the nature of the last meal in the stomach, the amount of rain-water in the victim's shoe, or footprints in a fresh fall of snow.

Less precise and requiring true expert appraisal is the rate method. This is based on the fact that the body temperature after death falls at a specific rate per hour. According to the American Medical Association, after death a body cools from the normal body temperature of 98.6°F at an average rate of about 1.5 degrees per hour. Therefore, taking the internal temperature of the body, subtracting this figure from 98.6, and dividing the result by 1.5 gives a measure of the time since death. This is affected by many factors, such as how the corpse is clothed or covered, and how fat it is—and all these conditions must be considered in the calculations.

"Sudden death" even from a massive heart attack or in shock on the operating table, is not really sudden. After the heart stops, there may be a few last, shallow breaths. The brain lives on for five or six minutes, or longer under some conditions.

When heart stoppage cuts off the blood supply, the brain can no longer get oxygen to burn sugar for its energy. So it switches to a cruder, less efficient way of breaking down sugar without blood-borne oxygen (anaerobic glycolysis) to extract whatever energy it can. This emergency system will work for about six minutes. If the body is revived during this time, the brain makes a gradual transition, taking half an hour, back to using oxygen.

It has recently become clear that resuscitation with oxygen must be done carefully to avoid flooding the brain with oxygen. If resuscitation is begun within six minutes, so that

oxygenated blood resumes its flow to the brain, the switch-over to brain refunctioning will be normal. Extra oxygen given too soon may damage the brain as surely as the lack of oxygen.

A powerful new drug to save the lives of people whose heart stops beating on the operating table is giving immediate and dramatic results. The drug is known a "Levophed." Recently it was injected, by Dr. Frederick A. Shannon and William N. Henry of Wickenburg, Arizona, into the right ventricle of the heart of a 26-year-old man who had been "dead" more than four minutes. His heart resumed beating immediately.

The compound belongs to the class of drugs called pressor amines, which act by constricting the blood vessels. It has previously proved lifesaving in its ability to elevate blood pressure from the shock level accompanying a severe heart attack.

Of great significance to the Arizona surgeons was the fact the patient recovered completely and was back driving a truck less than two months after the operation. Some doctors believe the brain cannot survive more than three minutes after the heart stops beating without suffering permanent damage.

When the patient's heart failed suddenly during the closing of an incision following an appendectomy, the doctors started forced respiration with oxygen. Three minutes later, the chest was opened to permit massage of his heart, and then a large dose of Levophed was injected.

The patient began to breathe in the next ten minutes. With the exception of a brief period of excitability and moodiness, his recovery was complete, the doctors state.

As he ascended the gallows to settle political accounts with King Henry VIII, Sir Thomas More smiled wryly at the hangman. "See me safe up," he said, "for coming down I can shift for myself."

Few people face death with such gallantry. The very terms we use for death express a universal fear: grim reaper, dark angel.

Yet all evidence indicates that death has few terrors. It is generally welcomed by the aged and infirm. It offers merciful release to the sick, lifting burdens they can no longer carry. The overwhelming majority of people are willing to meet death when it comes, although they have feared it all their lives.

A willingness to die

Many physicians with whom I have talked have told me that death is almost always preceded by a perfect willingness to die. It is always easy at the last. However great the previous suffering, there is always an interval of perfect peace and often ecstasy before death.

All competent observers agree that except in imagination there is no such thing as death agony. The contractions of the dying body, it is true, are sometimes distressing sights. They seem to be evidence of suffering but this is only seemingly so—they are merely the contractions of reflex muscles.

One pathologist I know well, explained the physical transitions that accompany a natural death in the following manner:

"The final flutters of a failing heart pump an ever-diminishing supply of blood. The flame of life burns more and more dimly. Whatever pain may have been evident disappears as sensory perceptions fail.

Without pain or sensation

"After an interval of peace, the oxygen starvation that goes with failing circulation takes its toll on the brain. The patient may hear the ringing of nonexistent bells or see the flashing of nonexistent lights. He may feel a slight restlessness. Gradually he drifts into darkness, without pain, without sensation. The final blacking out which precedes death is in no wise different from falling asleep. This is true of older people who often go to bed and to sleep—and never wake. It is also true of children. Almost always they die easily, painlessly."

In support of this current medical appraisal of the death process, it is interesting to recall that William Hunter, the 18th century anatomist, murmured with his last breath, "If I had strength enough to hold a pen I would write how easy and pleasant it is to die."

Wanted: botulism E antiserum

Food poisoning in the Detroit area from canned tuna and other cases resulting from prepared whitefish originating in the Great Lakes region have attracted interest in the dangers of type E botulism. Two of three Grosse Ille, Mich., women died after becoming ill with type E botulism as a result of eating canned tuna in 1963. An editorial in the *Journal of the American Medical Association* recommends that antiserum for type E botulism be readily available.

The only botulism antiserum now generally available in this country covers types A and B, but not type E. Only a limited supply of antiserum for type E is available—from Canadian and Danish sources.

From 1925 to 1960 there was only one reported instance of botulism from food commercially processed or canned in this country, although there have always been a number of small outbreaks yearly, the result mainly, of eating home-prepared foods, which have limited potential distribution.

Since 1932, there have been seven instances of type E botulism in the United States, resulting in 15 deaths, according to a *Journal* report. These occurred in 1932, 1934, 1941, 1960, 1961, and 1963, when there were two outbreaks. The tuna-poisoning and the tainted whitefish seem to have been attributable to type E toxin, previously uncommon in this country.

"The recent occurrences would seem," says the *Journal*, "to indicate a new endemic infection of marine wildlife with type E Clostridium botulinum. It appears likely that new and more stringent public health regulations, relating to commercial processing, will be necessary."

The dangers of modern medicine

by Arthur J. Snider

OF THE 1,014 patients who entered Grace-New Haven (Conn.) Hospital in an eight-month period, 198 suffered a medical complication for which the doctor's treatment was responsible in whole or part. Sixteen of the patients died as a result of the hospital mishaps.

In making this report on "The Hazards of Hospitalization," Dr. Elihu M. Schimmel of Yale University Medical School said it was not a matter of bad judgment or malpractice that brought about the mishaps. The purpose of the report was to call physicians' attention to the fact that there is a price to pay for medical progress.

The report, in the *Annals of Internal Medicine,* listed 16 "noxious episodes" that were considered to be "primary, precipitating or contributory factors" to the deaths.

The heart of an overweight woman suffering from high blood pressure stopped when she was being examined for bladder trouble. Another patient whose chest was being tapped to remove fluid died of abnormal heart rhythm. A middle-aged woman sustained a minor tear of the esophagus when a tube was inserted. This was deemed contributory to her death. Two patients died shortly after barium enemas, also deemed contributory. Nine deaths were associated with drug administration. In six of the cases, hospital-acquired infections were responsible.

Dr. Schimmel listed not only major mishaps but all others, regardless of severity. In all, there were 240 episodes involving 198 patients. They were minor in 110 cases, moderate in 82 and major in 48, including the 16 fatalities. These did not include the unavoidable discom-

forts a patient suffers, such as needle punctures or preparation for X-rays or biopsy.

"The economic loss and emotional disturbance suffered by many patients were beyond the scope of the study, yet cannot be considered insignificant complications of their medical care," said Dr. Schimmel.

Mean age of the 198 patients was 53, which was identical to the mean age of the 1,014 admitted to the medical service.

Dr. Schimmel notes that "modern medicine has introduced potent procedures that cannot always be considered harmless." But to seek absolute safety would in many cases mean doing nothing at a time when medicine has much in its power to help with.

At the same time, until safe procedures are developed, Dr. Schimmel says physicians can best serve their patients by "weighing each measure according to its goals and risks, by choosing only those that have been justified and by remaining prepared to alter the procedures when imminent or actual harm threatens to obliterate their good."

How a nose smells

Experts in osmics (science of smell) have long wondered how people's noses can tell a cigar from, say, ammonia. Now the evidence is shaping up to suggest that the sense of smell is based on the geometry of molecules.

Each odor appears to have characteristically shaped molecules which fit into their own receptors on the olfactory nerve, as a key fits into a lock.

Modern stereochemistry has made it possible to build three-dimensional models of odor substances.

Using this technique, two chemists and a physiologist have established the case for the stereochemical theory of odor.

While still a student at the University of Oxford, England, John E. Amoore, now a biochemist with the U.S. Department of Agriculture, analyzed 600 organic compounds listed in the literature as having odor and established that there were seven primaries among them.

They are: pungent, like vinegar; camphoraceous, like moth-repellent; musky, like angelic root oil; floral, like roses; pepperminty, like mint candy; putrid, like rotten eggs; and ethereal, like dry-cleaning fluid.

By mixing seven primary odors in varied proportions, just as a painter mixes the three primary colors (red, green, blue), every known odor can be produced.

Amoore then worked out the structural formulas for each of the odor compounds and built three-dimensional models of atomic units that were 100 million times actual size.

He found that the 100 compounds having a camphor-like odor all had about the same shape—spherical—and the same diameter, about seven angstroms. (An angstrom is one ten-millionth of a millimeter.)

The musky odor compounds were shaped like a disc, the floral odors like a disc with a kite-shape attached; the pepperminty, like a wedge; the ethereal, like a rod.

In each case, the olfactory nerve of the human being has a receptor to fit the molecule.

Only the pungent and putrid odors were exceptions to the shape-matching. In their case, the plug and socket effect was electrical rather than geometrical.

With the aid of Dr. James W. Johnston, a physiologist, and Dr. Martin Rubin, a chemist, both of Georgetown University, Dr. Amoore put the theory to several tests. They found that it's possible, for example, to synthesize a molecule to certain shapes and predict its odor accurately.

A molecule designed to fit three different slots, such as floral, peppermint and ether, will wind up with a predictable fruity, grape-like smell.

By constructing a molecule to fit in four slots, for example, it is possible to duplicate a cedarwood odor.

"Equipped now with a tested basic theory to guide further research, we can hope for much faster progress in osmics than has been possible heretofore," Amoore says in *Scientific American*. "This may lead to unexpected benefits for mankind.

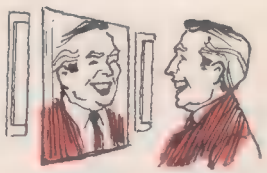
"For man, the sense of smell may perhaps have become less essential as a life-and-death organ than it is for lower animals, but we still depend on this sense much more than we realize."

Amoore believes the way should now be open to analyze in fine detail the complex flavors in food and drink, to get rid of obnoxious odors, to synthesize any odor desired, possibly develop an artificial nose to replace the bloodhound, or to become a diagnostic tool in medicine.

False teeth rehearsal

Now you can take your false teeth home to try on, in the privacy of your own living room.

A Michigan dentist specializing in replacement of missing teeth (prosthodontist) has devised varieties of wax teeth that can be inserted into baseplates. The patient can take several set-ups and try them on for smiles, smirks, grins and laughs as the family votes its approval.



Dr. Arthur V. Victor of Roseville, Mich., makes the wax teeth from his "tooth library," a collection built up through the years.

The desire for the natural look in

dentures has never been greater. "Patients want false teeth that do not look false," he says. "The true art of making dentures is to hide the art."

The concept of "dentogenics," a fairly recent introduction, attempts to match teeth to the patient's personality as well as his age and sex. In general, says Dr. Victor, the smile should expose the upper teeth but the extent is an individual characteristic and unique to each patient. In speech, both the upper and lower teeth should be exposed. In older patients, the lower teeth are more often exposed than the upper.

Exercise and heart trouble

As a nutritionist, Dr. Jean Mayer of Harvard University concedes it may seem odd for him to be suggesting that the interest in nutrition as a contributor to heart disease may be obscuring a number of factors which may be as important—insufficient sleep, cigarette smoking and a too-sedentary life, for example.

Insufficient sleep is a conjecture and the role of cigarette smoking is only suspect, but there is a mounting number of studies that clearly suggests lack of exercise plays an important part, he says.

He cites some of these in *Postgraduate Medicine:*

Food consumption of lumberjacks in five camps in eastern Finland averaged 4,763 calories a man, with 45 percent derived from fat. In contrast, only 35 percent of the calories taken by the local population was derived from fat. Despite this the serum cholesterol level, a prelude to heart disease in the opinion of many experts, was the same.

In a remote valley in the southern Swiss Alps, the nearest road usable by automobiles or carts is several miles away. All distances have to be walked. The people carry hay, wood, milk and building materials on their backs. Each day during the summer, they climb to the pastures 2,000 feet above the village to milk cows and bring back heavy containers for cheese making. Their cholesterol levels were found to be considerably lower than those of a group of working class men of similar ancestry, height, and weight studied in the city of Basel. The Alpine men ate an average of 3,643 calories a day, 34 percent of them fat. The urban Basel group by contrast ate 2,643 calories, of which 37 percent came from fat. Yet the rural Alpine men showed a much lower cholesterol level.

In the United States, the mortality from arteriosclerotic heart disease of clerks, switchmen and section hands on railroads was found to be in inverse proportion

to their physical activity. Clerks showed a higher rate of heart disease than did switchmen and section hands.

"Regular exercise of sufficient intensity may help to maintain the elasticity of blood vessels," says Dr. Mayer. "It thus appears that the entire mode of life, not nutrition alone, may be of importance in retarding or accelerating the occurrence of what has become, in this century, the number one killer in the United States."

Should medicine be labelled?

It's a tradition of medicine that the name of the drug not be put on the prescription label. One reason is, physicians do not want the patient to know when they are prescribing a dummy drug (placebo) to cure the patient's imaginary ailment. Another is that the patient may resort to self medication.

But Dr. James L. Wilson of the University of Michigan dissents from this view. The public has far greater sophistication today about medical problems, he says, adding: "With the reduction in prescriptions calling for placebos, the need for traditional secrecy about medications should be reconsidered. The experience of the University of Michigan is that the risk of self-medication has been negligible. It can be corrected in part by limitations written on the prescription to prevent refilling."

For the last 10 years, the University Hospital in Ann Arbor, Mich., has had a policy of identifying all dispensed drugs by giving the pharmaceutical name and the potency of the product on the label of the container.

When a patient goes from one physician to another, the new physician can find out immediately just what medication has been taken, more than the simple information that it is a little red pill "about so big."

In cases of poisoning or question of poisoning of a child, the drug can be identified immediately over the telephone after the parent reads the name off the bottle.

Thumbsucking and smoking

Thumbsuckers of infancy don't necessarily turn out to be the smoking teen-agers.

There is a Freudian theory that smokers seek the oral gratification obtained in early childhood. But Dr. Eva J. Salber of Harvard University School of Public Health could not find this association in a study of 314 pairs of students and their mothers in Newton, Mass.

There also was no correlation between smoking and breast or bottle feeding, time of weaning or intervals between feedings.

Behaviorial scientists use tests like the Peter-Paul goblet to measure human perception. Which do you see first—the goblet or the twins? Now try to switch your perception from one to the other.

The Bible of Behavior

As THE reader reaches the conclusion of Bernard Berelson and Gary A. Steiner's massive compendium *Human Behavior* (Harcourt, Brace & World, New York, 712 pp., $11), he can almost hear the authors sighing with relief.

"There they are:" the conclusion begins, "1045 numbered findings from the scientific study of human behavior. Not all absolutely true, not all final or definitive—but certainly among the best-established generalizations of this scope. Taken together, these findings reveal a good deal about the subjects studied in the behavioral sciences, the ways in which they are studied, and the kind of knowledge that emerges."

Messrs. Berelson and Stiner are too modest. One stands in respect, almost in awe, of the task they have completed. They have surveyed the literature of human behavior, a field of inquiry that contains more than its share of jargon, redundancy and downright nonsense, and compressed it into a single, clearly written book. With the aid of this single book, the layman can discover just what the diffuse field of behaviorial science is and where it stands today.

After reviewing all the studies and reports, the authors differ on the record of the behaviorial sciences. "Actually, one of us believes that the accumulated knowledge is impressive for only a few decades. (Did any science do much better in its first seventy-five years or so?) The other is a little disappointed that the record is not better."

Still, the two of them agree on some fascinating findings. Some of them are part of our general knowledge:

"It is probably fair to summarize the matter (of the comparative intelligence of Negroes and whites in the United States) by saying that most specialists in the subject believe that inherent or genetic differences in intelligence between the races have not been established.

"As a result of prejudice and discrimination, members of the minority group often suffer some deterioration of personality: self-doubt, self hate, impulsive and superstitious behavior, resigned exploitation of inferior status, deviant behavior, family disturbance, mental illness."

"Prolonged separation from the mother and a secure home environment (as in the case of hospitalized or institutionalized children) beyond

the age of three months and up to about five years . . . seems to lead to serious emotional and intellectual retardation. . . ."

"Television viewing by children is heaviest among the duller and emotionally insecure."

Other findings will doubtless be disputed by many:

"There is no conclusive evidence that psychotherapy is more effective than general medical counseling or advice in treating a neurosis or psychosis. Strictly speaking, it cannot even be considered established that psychotherapy, on the average, improves a patient's chances of recovery beyond what they would be without any formal therapy whatsoever."

"Premarital sexual relations are allowed in a clear majority of human societies, but extra-marital relations are almost universally condemned."

The nature of man

The chapter that explores the "Big Question: The Nature of Man," begins with a quote from Jonathan Swift, "Happiness is a perpetual possession of being well deceived."

"For the truth is, apparently," say authors Berelson and Steiner, "that no matter how successful man becomes in dealing with his problems, he still finds it hard to live in the real world, undiluted: to see what one really is, to hear what others really think of one, to face the conflicts and threats really present, or, for that matter, the bare human feelings. Animals adjust to their environment more or less on its terms; man maneuvers his world to suit himself, within far broader limits."

Man can alter his world through language: "Not only can things be named, manipulated, studied, preserved, and communicated, all without any physical contact; things can be called by other than their real names, and names can be devised to suit occasions, thus adding innumerable (and inexpensive) opportunities for gratification as well as control. . . . More often than not, in social life, the word can be applied to fit occasions more easily than the occasion modified to fit the word."

The bulk of the findings, the authors comment, point to the strains placed on the individual in our open, fast-changing society. Our life, our reality come from one source, other people. "Nearly all of these findings lead the individual directly to other people—not only for facts and beliefs about the nature of the world, but also for what he has learned to want, to value, to consider right and good, to worship.

"In maintaining man's morale, the small group around him is often more important than the large issues involved; in political affairs, he votes with his friends as well as for the candidates; in the search for rationality and for the good, it is the surrounding group that sets the standard; the right, from religion to etiquette, is what one's peers agree is right."—*D.C.*

Science in the news

Physicists figure they have found a way to tabulate subatomic particles just as the Periodic Table arranges the elements.

Ever since the atom was first split, physicists have been discovering scores of particles, but no unified way to relate them to each other. Japan's Professor Y. Ohnuki in 1960 suggested a mathematical approach called "unitary transformations." Americans, Britons and Israelis worked on the notion and found a nuclear network that made sense--except for one thing. It required a particle not yet discovered.

Brookhaven National Laboratory has now discovered the particle, called omega minus, almost precisely as the theoreticians said it would be discovered.

The new law of physics is known as the "eightfold way" because it is based on eight properties of subatomic particles, and Buddha called his formula of eight virtues for the relief of pain by that name.

Britain's Prof. Paul T. Matthews, of Imperial College, London, announced the breakthrough. He added: "High-energy physicists are walking around as though they are witnessing the apple landing on Newton's head."

Scientists at Oak Ridge National Laboratory reported progress in efforts to control thermonuclear reactions for peaceful purposes. In a 15-foot-long machine called the DCX-2, they have fired hydrogen atoms into a magnetic field. By adjusting the magnetic field, they have made the atoms collide with such impact that they're sure they can produce fusion and, eventually, transform that into electrical power.

Are there "abominable snowmen?" A Soviet scientist believes there are. Prof. Boris Porshnev says the big two-legged creatures reportedly sighted in the Eurasian mountains in recent years may be survivors of the Neanderthal race, which is known to have lived 30 to 60 thousand years ago.

The National Opinion Research Center published a report on a survey of how people reacted to President Kennedy's death. Fifty-three percent said they wept at the news. Ninety percent reported some physical discomfort during the next four days.

The Coast Guard began its iceberg patrol this spring with a new device. Installed in two Hercules C-130 planes, it's a microwave radiometer which measures the temperature of distant objects by the radar-frequency waves they emit. Ships and icebergs can look the same on radar, but the radiometers detect the differences in temperature between the two and tell which is which.

Science in the news

Missiles and Rockets, a space engineering journal, said that a lunar landing this decade looks impossible. Reason: "Early slippage in the Saturn 5 booster program." Blamed: "Congressional cuts in funding." Meanwhile, NASA did some trimming of its own, cutting several thousands of pounds from the Apollo spacecraft that will carry astronauts to the moon. Apollo had become almost too heavy to be lifted. The astronauts will now land on the moon standing up. The trimming job cost them their seats. NASA also decided to return the astronauts to the Pacific, not the U.S. Safer.

Down-to-earth note: At NASA's request, people in western Iowa are looking for pieces of the moon during spring plowing. Several fragments believed to be lunar were found there last summer. The stones may tell NASA what the moon is made of.

What else is happening in space: NASA will send up six "biosatellites" into earth orbits and into outer space to see how monkeys, and thus presumably men, survive prolonged space travel....Lockheed told NASA that a U.S. scientific space station with 24 crew members aboard can be orbiting the earth in 1968....A command from earth made Syncom 2 shoot hydrogen peroxide gas from its jets to move it from South America to the Pacific. Object: to have it relay Olympics TV from Tokyo....The Imp satellite found a turbulent region around earth where solar winds hit its magnetic field.

Scientists passed another milestone in cancer research. The New York Times said Columbia's Drs. Ernest Borek and P.R. Srinivasan have found evidence of a unified theory of cancer development. The theory suggests that normal cells become malignant as the result of changes in the distribution of bunches of atoms in the genetic and protein-making systems in living cells.

New drugs came, went and were scrutinized. A compound called DMSO tested at the U. of Oregon was reported to relieve the pain of bursitis in 20 minutes....A drug called Valium (by Hoffman-La Roche) was said to produce "dramatic" results in the treatment of a form of cerebral palsy....The Food and Drug Administration requested the withdrawal of a drug for mental depression by the name of Parnate. FDA said the drug increased blood pressure in some patients.... FDA also began a review of drugs developed since 1938 to check their effectiveness.

The Journal of the American Medical Association reported that five men who had become sterile in a "nuclear excursion" accident at Oak Ridge in 1958 had recovered their fertility after two years.

QUOTE OF THE MONTH: "The condition of our survival on this pillaged planet is a new interdependence between biological species." --DR. JOHN R. DUNNING, Dean of Columbia's School of Engineering and Applied Science.

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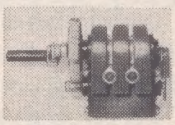

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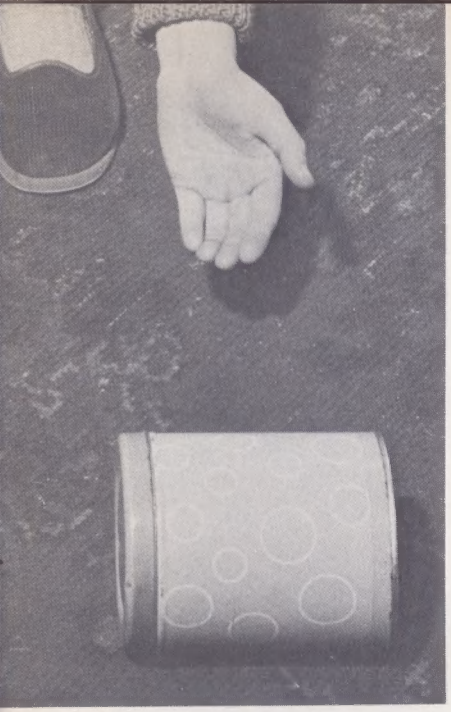
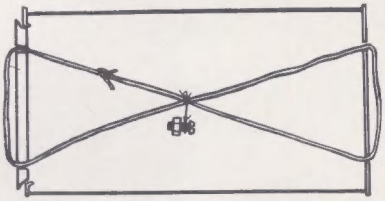


Fig. 1
Make two holes in the lid and two holes in the bottom of the tin

Fig. 2
Weight tied to rubber band where it crosses in the centre of the tin



The can that comes back

You will need: A round can with lid, nail, hammer, rubber bands, thread, nut and bolt.

Your knowledge of the force of gravity will enable you to construct a simple mechanical toy which will obediently return when you roll it away.

Begin by hammering two holes in the lid and two holes in the bottom of the can with a nail.

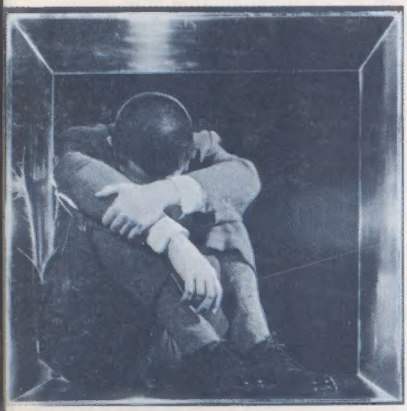
Cut a long rubber band (or several knotted together) and pass it through the four holes in figure-of-eight fashion. See diagram. Tie ends of the rubber band together again.

Now tie a small weight, such as a piece of lead or nut and bolt, to the center of the rubber band, where it crosses inside the can.

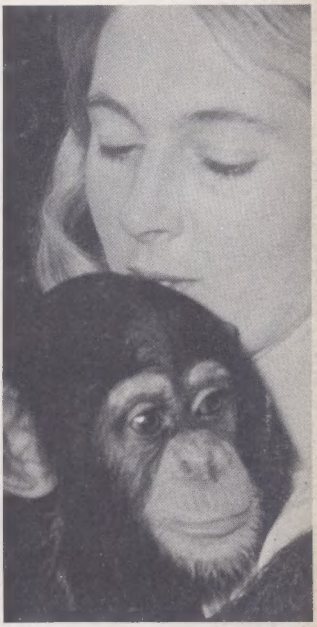
Replace the lid and roll the can away from you. The weight supplies a lowered center of gravity which winds up the rubber band. When the force you have used has been expended, the band will unwind and the can will slowly roll back to you.

The thicker the rubber band, the quicker the toy will return.

Also in this issue . . .



Alcoholism, experts say, is a trap from which there is only one escape —total abstinence. Now a controversial British report has challenged this and contends that some former alcoholics can become normal drinkers. Page 31.



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British scientist Jane Goodall watched worms in bed as a child. She now watches chimpanzees in the jungle. With extraordinary patience, she has made remarkable new discoveries about the chimp, the most human of all the apes. Page 74.

Deep in the jungles of Brazil live tribes of primitive indians who are survivors of the stone age. Now civilization is pressing in on these people, and their way of life may soon disappear forever. Photographers for the World Health Organization recently were able to record the life of these jungle dwellers for posterity. Their remarkable photographs illustrate the story that begins on page 46.

Man's eye, restless, seeing farther and farther into space, is symbolic of the future of man, as shown in one of the most impressive exhibits at the New York World's Fair. The show will present an 18-minute history of man. For a one-minute story of that, see page 22.

The two-headed snake couldn't make up its minds which head should eat first. One day the heads had a fight and later the snake was found dead. Was it murder or suicide? The story of the snake and other creepy freaks—natural and man-made —begins on page 5.